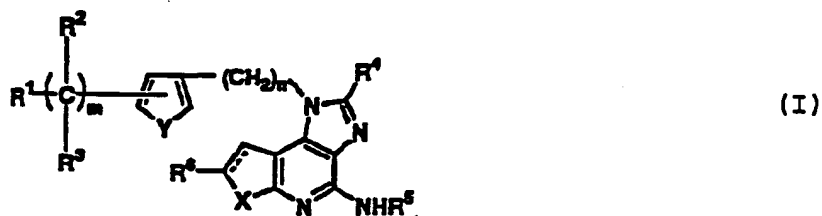


CLAIMS

1. A 1-(substituted aryl)alkyl-1H-imidazopyridine-4-amine derivative represented by the following general formula (I):



wherein R^1 is a group represented by COR^7 , $SO_2NR^8R^9$, $CONR^8R^9$, $NR^{10}R^{11}$ or $C(R^{12})=NOH$, or a hydroxyl group or cyano group; R^2 and R^3 are the same or different and represent hydrogen atoms or lower alkyl groups; R^4 represents a hydrogen atom or a linear or branched alkyl group of 1-10 carbon atoms which may be substituted with one or more hydroxyl groups, lower alkoxy groups, cyclic alkyl groups or halogen atoms; R^5 represents a hydrogen atom or lower alkyl group; R^6 represents a hydrogen atom, lower alkyl group, lower alkoxy group or halogen atom; R^7 represents a hydroxyl group, lower alkyl group or lower alkoxy group; R^8 and R^9 are the same or different and represent hydrogen atoms or lower alkyl groups; R^{10} represents a hydrogen atom, lower alkyl group or benzyl group; R^{11} represents a hydrogen atom, lower alkyl group, benzyl group, lower alkanesulfonyl group, lower alkanoyl group, substituted or unsubstituted carbamoyl group, substituted or unsubstituted thiocarbamoyl group or substituted or unsubstituted benzenesulfonyl group; R^{12} represents a hydrogen atom or lower alkyl group; m represents an integer of 0-1, n represents an integer of 1-3; X represents an alkylene chain of 1-3 carbon atoms or the carbon chain represented by $CH=CH$; Y represents a sulfur atom or the carbon chain represented by $CH=CH$; and the bonds shown by solid lines and dotted lines are single bonds or double bonds, or a pharmacologically acceptable salt thereof.

DETAILED DESCRIPTION OF THE INVENTION

Technical Field of the Invention

The present invention relates to a novel 1-(substituted

aryl)alkyl-1H-imidazopyridine-4-amine derivative or pharmacologically acceptable salt thereof, which induces biosynthesis of interferon and is useful as an antiviral agent or anticancer drug.

Prior Art

Compounds with a 1H-imidazopyridine-4-amine skeleton have been disclosed, such as the compounds with anti-viral action mentioned in Japanese Unexamined Patent Publication No. 60-123488, including 1-isobutyl-1H-imidazo[4,5-c]quinoline-4-amine (common name: imiquimod) and 1-(2-phenylethyl)-1H-imidazo[4,5-c]quinoline-4-amine, but absolutely no 1H-imidazopyridine-4-amine derivatives have hitherto been known having substituents with functional groups such as sulfamoyl, carbamoyl, amino, amido, sulfonamide, cyano, carboxyl, ureido, thioureido, hydroxyiminomethyl or hydroxyl groups on the aromatic ring of the primary arylalkyl group, such as according to the present invention.

Problems to be Solved by the Invention

The aforementioned imiquimod is known to have interferon biosynthesis-inducing action as described in Journal of Interferon Research, Vol.14, p.81 (1994) and elsewhere, while compounds with similar action are also known, such as 2-amino-5-bromo-6-phenyl-4(3H)-pyrimidinone (common name: bropirimine) [Journal of Medicinal Chemistry, Vol.23, p.237 (1980)] and 2,7-bis[2-(diethylamino)ethoxy]-9H-fluoren-9-one (common name: tilorone) (The Merck Index, 12th Edition, 9581); however, as of the time of this writing it cannot be said that their activities are sufficient.

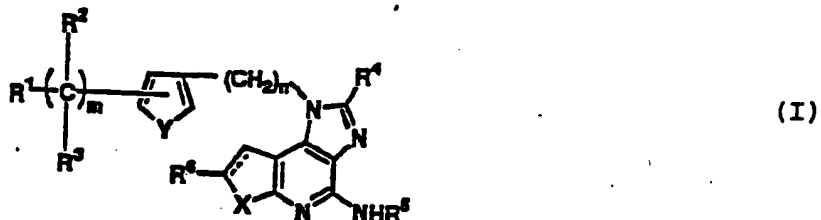
It is an object of the present invention to provide novel compounds with excellent interferon inductivity which are useful for diseases caused by viruses, such as rheumatoid arthritis, warts, hepatitis B, hepatitis C, etc. and for cancer and other neoplastic diseases.

Means for Solving the Problems

As a result of diligent research aimed at achieving the object described above, the present inventors have completed the present invention upon the finding that novel 1-(substituted aryl)alkyl-1H-imidazopyridine-4-amine derivatives having

substituents with functional groups such as sulfamoyl, carbamoyl, amino, amido, sulfonamide, cyano, carboxyl, ureido, thioureido, hydroxyiminomethyl or hydroxyl groups on the aromatic ring of the primary arylalkyl group, and pharmacologically acceptable salts thereof, have excellent interferon inductivity.

In other words, the present invention relates to 1-(substituted aryl)alkyl-1H-imidazopyridine-4-amine derivatives represented by the following general formula (I):



wherein R^1 is a group represented by COR^7 , $SO_2NR^8R^9$, $CONR^8R^9$, $NR^{10}R^{11}$ or $C(R^{12})=NOH$, or a hydroxyl group or cyano group; R^2 and R^3 are the same or different and represent hydrogen atoms or lower alkyl groups; R^4 represents a hydrogen atom or a linear or branched alkyl group of 1-10 carbon atoms which may be substituted with one or more hydroxyl groups, lower alkoxy groups, cyclic alkyl groups or halogen atoms; R^5 represents a hydrogen atom or lower alkyl group; R^6 represents a hydrogen atom, lower alkyl group, lower alkoxy group or halogen atom; R^7 represents a hydroxyl group, lower alkyl group or lower alkoxy group; R^8 and R^9 are the same or different and represent hydrogen atoms or lower alkyl groups; R^{10} represents a hydrogen atom, lower alkyl group or benzyl group; R^{11} represents a hydrogen atom, lower alkyl group, benzyl group, lower alkanesulfonyl group, lower alkanoyl group, substituted or unsubstituted carbamoyl group, substituted or unsubstituted thiocarbamoyl group or substituted or unsubstituted benzenesulfonyl group; R^{12} represents a hydrogen atom or lower alkyl group; m represents an integer of 0-1, n represents an integer of 1-3; X represents an alkylene chain of 1-3 carbon atoms or the carbon chain represented by $CH=CH$; Y represents a sulfur atom or the carbon chain represented by $CH=CH$; and the bonds shown by solid lines and dotted lines are single bonds or double bonds, and pharmacologically acceptable salts thereof.

[Preferred Mode of the Invention]

As examples of lower alkyl groups represented by R^1 , R^2 , R^3 , R^4 , R^5 , R^6 , H^7 , R^{10} , R^{11} or R^{12} in general formula (I) above there may be mentioned methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, sec-butyl, tert-butyl, etc., as examples of linear or branched alkyl groups of 1-10 carbon atoms represented by R^6 there may be mentioned methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, sec-butyl, tert-butyl, n-pentyl, isopentyl, neopentyl, n-hexyl, n-heptyl, n-octyl, n-nonyl, n-decyl, etc., as examples of lower alkoxy groups which may be substituted on these alkyl groups there may be mentioned methoxy, ethoxy, n-propoxy, isopropoxy, n-butoxy, isobutoxy, sec-butoxy, tert-butoxy, etc., as examples of cyclic alkyl groups which may be substituted on these alkyl groups there may be mentioned cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl, etc., and as examples of halogen atoms which may be substituted on these alkyl groups there may be mentioned fluorine, chlorine, bromine and iodine. As examples of lower alkoxy groups represented by R^6 and R^7 there may be mentioned methoxy, ethoxy, n-propoxy, isopropoxy, n-butoxy, isobutoxy, sec-butoxy, tert-butoxy, etc., and as examples of halogen atoms represented by R^6 there may be mentioned fluorine, chlorine, bromine and iodine. As lower alkanesulfonyl groups represented by R^{11} there may be mentioned methanesulfonyl, propanesulfonyl, butanesulfonyl, etc., and as lower alkanoyl groups represented by R^{12} there may be mentioned acetyl, propionyl, butyryl, etc. As examples of substituents on the substituted or unsubstituted carbamoyl group, substituted or unsubstituted thiocarbamoyl group or substituted or unsubstituted benzenesulfonyl group represented by R^{11} there may be mentioned lower alkyl groups, lower alkoxy groups, halogen atoms, etc.

The compounds represented by general formula (I) above according to the invention may be converted to pharmacologically acceptable salts, and the bases may also be dissociated from the produced salts, depending on the need.

As examples of pharmacologically acceptable salts of the compounds represented by general formula (I) above according to the invention there may be mentioned acid addition salts, as

well as mineral acid salts of hydrochloric acid, hydrobromic acid, hydroiodic acid, nitric acid, sulfuric acid, phosphoric acid, etc. and organic acid salts of acetic acid, maleic acid, fumaric acid, citric acid, oxalic acid, malic acid, methanesulfonic acid, p-toluenesulfonic acid, mandelic acid, 10-camphor sulfonic acid, tartaric acid, etc.

Optical isomers may be present for compounds with asymmetric carbons among the compounds represented by general formula (I) above according to the invention, and these optically active species and their mixtures are also encompassed by the present invention.

Also, the compounds represented by general formula (I) above according to the invention and their pharmacologically acceptable salts may exist in any desired crystalline form depending on the production conditions or they may exist as any desired hydrates, and these crystalline forms and hydrates, as well as mixtures thereof, are also encompassed by the present invention.

As preferred modes of the 1-(substituted aryl)alkyl-1H-imidazopyridine-4-amine derivatives of the invention there may be mentioned the compounds mentioned in the examples provided below, as well as the following compounds and their pharmacologically acceptable salts, with the understanding that the invention is not limited to these.

- (1) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
- (2) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-methyl-1H-imidazo[4,5-c]quinoline-4-amine
- (3) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-ethyl-1H-imidazo[4,5-c]quinoline-4-amine
- (4) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-n-propyl-1H-imidazo[4,5-c]quinoline-4-amine
- (5) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-n-butyl-1H-imidazo[4,5-c]quinoline-4-amine
- (6) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-cyclopropylmethyl-1H-imidazo[4,5-c]quinoline-4-amine
- (7) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-ethoxymethyl-1H-

- imidazo[4,5-c]quinoline-4-amine
- (8) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
- (9) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-6,7,8,9-tetrahydro-2-methyl-1H-imidazo[4,5-c]quinoline-4-amine
- (10) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-ethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
- (11) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-6,7,8,9-tetrahydro-2-n-propyl-1H-imidazo[4,5-c]quinoline-4-amine
- (12) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-n-butyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
- (13) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-cyclopropylmethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
- (14) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-ethoxymethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
- (15) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (16) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-1,6,7,8-tetrahydro-2-methylcyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (17) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-ethyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (18) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-1,6,7,8-tetrahydro-2-n-propylcyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (19) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-n-butyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (20) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-cyclopropylmethyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (21) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-ethoxymethyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (22) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine
- (23) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-1,6,7,8,9,10-hexahydro-2-methylcyclohepta[b]imidazo[4,5-d]pyridine-4-amine
- (24) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-ethyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine

- (25) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-1,6,7,8,9,10-hexahydro-2-n-propylcyclohepta[b]imidazo[4,5-d]pyridine-4-amine
- (26) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-n-butyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine
- (27) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-cyclopropylmethyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine
- (28) 1-[2-[4-(1-aminoethyl)phenyl]ethyl]-2-ethoxymethyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine
- (29) N-[1-[4-[2-(4-amino-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (30) N-[1-[4-[2-(4-amino-2-methyl-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (31) N-[1-[4-[2-(4-amino-2-ethyl-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (32) N-[1-[4-[2-(4-amino-2-n-propyl-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (33) N-[1-[4-[2-(4-amino-2-n-butyl-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (34) N-[1-[4-[2-(4-amino-2-cyclopropylmethyl-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (35) N-[1-[4-[2-(4-amino-2-ethoxymethyl-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (36) N-[1-[4-[2-(4-amino-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (37) N-[1-[4-[2-(4-amino-6,7,8,9-tetrahydro-2-methyl-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (38) N-[1-[4-[2-(4-amino-2-ethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (39) N-[1-[4-[2-(4-amino-6,7,8,9-tetrahydro-2-n-propyl-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (40) N-[1-[4-[2-(4-amino-2-n-butyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (41) N-[1-[4-[2-(4-amino-2-cyclopropylmethyl-6,7,8,9-tetrahydro-

- 1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (42) N-[1-[4-[2-(4-amino-2-ethoxymethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl]ethyl] acetamide
- (43) N-[1-[4-[2-(4-amino-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (44) N-[1-[4-[2-(4-amino-1,6,7,8-tetrahydro-2-methylcyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (45) N-[1-[4-[2-(4-amino-2-ethyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (46) N-[1-[4-[2-(4-amino-1,6,7,8-tetrahydro-2-n-propylcyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (47) N-[1-[4-[2-(4-amino-2-n-butyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (48) N-[1-[4-[2-(4-amino-2-cyclopropylmethyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (49) N-[1-[4-[2-(4-amino-2-ethoxymethyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (50) N-[1-[4-[2-(4-amino-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (51) N-[1-[4-[2-(4-amino-1,6,7,8,9,10-hexahydro-2-methylcyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (52) N-[1-[4-[2-(4-amino-2-ethyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (53) N-[1-[4-[2-(4-amino-1,6,7,8,9,10-hexahydro-2-n-propylcyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide
- (54) N-[1-[4-[2-(4-amino-2-n-butyl-1,6,7,8,9,10-

hexahydrocyclohepta[b]imidazo[4,5-d]pyridin-1-yl)
ethyl]phenyl]ethyl] acetamide

(55) N-[1-[4-[2-(4-amino-2-cyclopropylmethyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide

(56) N-[1-[4-[2-(4-amino-2-ethoxymethyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]ethyl] acetamide

(57) 1-[2-[4-(aminomethyl)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine

(58) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-methyl-1H-imidazo[4,5-c]quinoline-4-amine

(59) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-ethyl-1H-imidazo[4,5-c]quinoline-4-amine

(60) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-n-propyl-1H-imidazo[4,5-c]quinoline-4-amine

(61) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-n-butyl-1H-imidazo[4,5-c]quinoline-4-amine

(62) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-cyclopropylmethyl-1H-imidazo[4,5-c]quinoline-4-amine

(63) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-ethoxymethyl-1H-imidazo[4,5-c]quinoline-4-amine

(64) 1-[2-[4-(aminomethyl)phenyl]ethyl]-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine

(65) 1-[2-[4-(aminomethyl)phenyl]ethyl]-6,7,8,9-tetrahydro-2-methyl-1H-imidazo[4,5-c]quinoline-4-amine

(66) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-ethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine

(67) 1-[2-[4-(aminomethyl)phenyl]ethyl]-6,7,8,9-tetrahydro-2-n-propyl-1H-imidazo[4,5-c]quinoline-4-amine

(68) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-n-butyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine

(69) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-cyclopropylmethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine

(70) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-ethoxymethyl-6,7,8,9-

tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
 (71) 1-[2-[4-(aminomethyl)phenyl]ethyl]-1,6,7,8-
 tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (72) 1-[2-[4-(aminomethyl)phenyl]ethyl]-1,6,7,8-tetrahydro-2-
 methylcyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (73) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-ethyl-1,6,7,8-
 tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (74) 1-[2-[4-(aminomethyl)phenyl]ethyl]-1,6,7,8-tetrahydro-2-n-
 propylcyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (75) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-n-butyl-1,6,7,8-
 tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (76) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-cyclopropylmethyl-
 1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (77) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-ethoxymethyl-1,6,7,8-
 tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (78) 1-[2-[4-(aminomethyl)phenyl]ethyl]-1,6,7,8,9,10-
 hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (79) 1-[2-[4-(aminomethyl)phenyl]ethyl]-1,6,7,8,9,10-hexahydro-
 2-methylcyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (80) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-ethyl-1,6,7,8,9,10-
 hexahydrocyclohepta-[b]imidazo[4,5-d]pyridine-4-amine
 (81) 1-[2-[4-(aminomethyl)phenyl]ethyl]-1,6,7,8,9,10-hexahydro-
 2-n-propylcyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (82) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-n-butyl-1,6,7,8,9,10-
 hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (83) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-cyclopropylmethyl-
 1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-
 amine
 (84) 1-[2-[4-(aminomethyl)phenyl]ethyl]-2-ethoxymethyl-
 1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-
 amine
 (85) 1-[2-(4-aminophenyl)ethyl]-1H-imidazo[4,5-c]quinoline-4-
 amine
 (86) 1-[2-(4-aminophenyl)ethyl]-2-methyl-1H-imidazo[4,5-
 c]quinoline-4-amine

- (87) 1-[2-(4-aminophenyl)ethyl]-2-ethyl-1H-imidazo[4,5-c]quinoline-4-amine
- (88) 1-[2-(4-aminophenyl)ethyl]-2-n-propyl-1H-imidazo[4,5-c]quinoline-4-amine
- (89) 1-[2-(4-aminophenyl)ethyl]-2-n-butyl-1H-imidazo[4,5-c]quinoline-4-amine
- (90) 1-[2-(4-aminophenyl)ethyl]-2-cyclopropylmethyl-1H-imidazo[4,5-c]quinoline-4-amine
- (91) 1-[2-(4-aminophenyl)ethyl]-2-ethoxymethyl-1H-imidazo[4,5-c]quinoline-4-amine
- (92) 1-[2-(4-aminophenyl)ethyl]-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
- (93) 1-[2-(4-aminophenyl)ethyl]-6,7,8,9-tetrahydro-2-methyl-1H-imidazo[4,5-c]quinoline-4-amine
- (94) 1-[2-(4-aminophenyl)ethyl]-2-ethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
- (95) 1-[2-(4-aminophenyl)ethyl]-6,7,8,9-tetrahydro-2-n-propyl-1H-imidazo[4,5-c]quinoline-4-amine
- (96) 1-[2-(4-aminophenyl)ethyl]-2-n-butyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
- (97) 1-[2-(4-aminophenyl)ethyl]-2-cyclopropylmethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
- (98) 1-[2-(4-aminophenyl)ethyl]-2-ethoxymethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-4-amine
- (99) 1-[2-(4-aminophenyl)ethyl]-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (100) 1-[2-(4-aminophenyl)ethyl]-1,6,7,8-tetrahydro-2-methylcyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (101) 1-[2-(4-aminophenyl)ethyl]-2-ethyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (102) 1-[2-(4-aminophenyl)ethyl]-1,6,7,8-tetrahydro-2-n-propylcyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (103) 1-[2-(4-aminophenyl)ethyl]-2-n-butyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
- (104) 1-[2-(4-aminophenyl)ethyl]-2-cyclopropylmethyl-1,6,7,8-

tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (105) 1-[2-(4-aminophenyl)ethyl]-2-ethoxymethyl-1,6,7,8-
 tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (106) 1-[2-(4-aminophenyl)ethyl]-1,6,7,8,9,10-
 hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (107) 1-[2-(4-aminophenyl)ethyl]-1,6,7,8,9,10-hexahydro-2-
 methylcyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (108) 1-[2-(4-aminophenyl)ethyl]-2-ethyl-1,6,7,8,9,10-
 hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (109) 1-[2-(4-aminophenyl)ethyl]-1,6,7,8,9,10-hexahydro-2-n-
 propylcyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (110) 1-[2-(4-aminophenyl)ethyl]-2-n-butyl-1,6,7,8,9,10-
 hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (111) 1-[2-(4-aminophenyl)ethyl]-2-cyclopropylmethyl-
 1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-
 amine
 (112) 1-[2-(4-aminophenyl)ethyl]-2-ethoxymethyl-1,6,7,8,9,10-
 hexahydrocyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (113) N-[4-[2-(4-amino-1H-imidazo[4,5-c]quinoline-1-
 yl)ethyl]phenyl] acetamide
 (114) N-[4-[2-(4-amino-2-methyl-1H-imidazo[4,5-c]quinoline-1-
 yl)ethyl]phenyl] acetamide
 (115) N-[4-[2-(4-amino-2-ethyl-1H-imidazo[4,5-c]quinoline-1-
 yl)ethyl]phenyl] acetamide
 (116) N-[4-[2-(4-amino-2-n-propyl-1H-imidazo[4,5-c]quinoline-1-
 yl)ethyl]phenyl] acetamide
 (117) N-[4-[2-(4-amino-2-n-butyl-1H-imidazo[4,5-c]quinoline-1-
 yl)ethyl]phenyl] acetamide
 (118) N-[4-[2-(4-amino-2-cyclopropylmethyl-1H-imidazo[4,5-
 c]quinoline-1-yl)ethyl]phenyl] acetamide
 (119) N-[4-[2-(4-amino-2-ethoxymethyl-1H-imidazo[4,5-
 c]quinoline-1-yl)ethyl]phenyl] acetamide
 (120) N-[4-[2-(4-amino-6,7,8,9-tetrahydro-1H-imidazo[4,5-
 c]quinoline-1-yl)ethyl]phenyl] acetamide
 (121) N-[4-[2-(4-amino-6,7,8,9-tetrahydro-1H imidazo[4,5-

c]quinoline-1-yl)ethyl]phenyl] acetamide

(122) N-[4-[2-(4-amino-2-ethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl] acetamide

(123) N-[4-[2-(4-amino-6,7,8,9-tetrahydro-2-n-propyl-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl] acetamide

(124) N-[4-[2-(4-amino-2-n-butyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl] acetamide

(125) N-[4-[2-(4-amino-2-cyclopropylmethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl] acetamide

(126) N-[4-[2-(4-amino-2-ethoxymethyl-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinoline-1-yl)ethyl]phenyl] acetamide

(127) N-[4-[2-(4-amino-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl] acetamide

(128) N-[4-[2-(4-amino-1,6,7,8-tetrahydro-2-methylcyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl] acetamide

(129) N-[4-[2-(4-amino-2-ethyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl] acetamide

(130) N-[4-[2-(4-amino-1,6,7,8-tetrahydro-2-n-propylcyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl] acetamide

(131) N-[4-[2-(4-amino-2-n-butyl-1,6,7,8-tetrahydro-2-cyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl] acetamide

(132) N-[4-[2-(4-amino-2-cyclopropylmethyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl] acetamide

(133) N-[4-[2-(4-amino-2-ethoxymethyl-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl] acetamide

(134) N-[4-[2-(4-amino-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl] acetamide

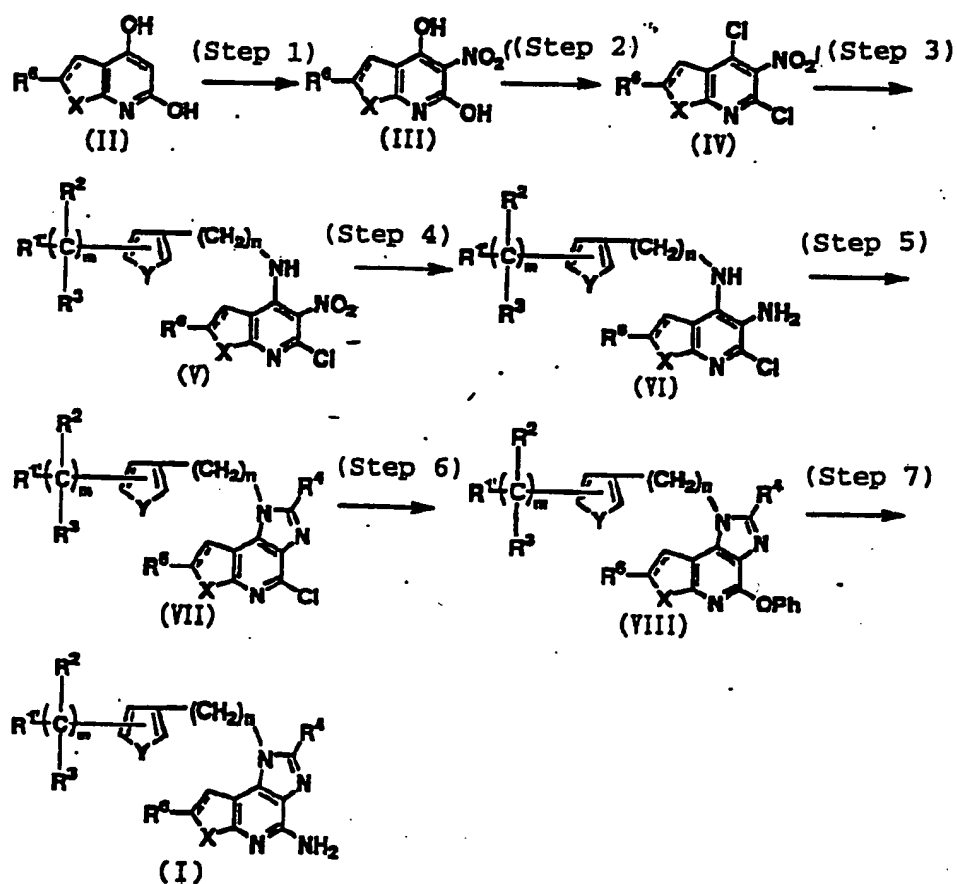
(135) N-[4-[2-(4-amino-1,6,7,8,9,10-hexahydro-2-methylcyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl] acetamide

(136) N-[4-[2-(4-amino-2-ethyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl] acetamide

- (137) N-[4-[2-(4-amino-1,6,7,8,9,10-hexahydro-2-n-propylcyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]acetamide
- (138) N-[4-[2-(4-amino-2-n-butyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]acetamide
- (139) N-[4-[2-(4-amino-2-cyclopropylmethyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]acetamide
- (140) N-[4-[2-(4-amino-2-ethoxymethyl-1,6,7,8,9,10-hexahydrocyclohepta[b]imidazo[4,5-d]pyridin-1-yl)ethyl]phenyl]acetamide
- (141) 1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
- (142) 2-methyl-1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
- (143) 2-ethyl-1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
- (144) [2-[4-(methylamino)phenyl]ethyl]-2-n-propyl-1H-imidazo[4,5-c]quinoline-4-amine
- (145) 2-n-butyl-1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
- (146) 2-cyclopropylmethyl-1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
- (147) 2-ethoxymethyl-1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
- (148) 6,7,8,9-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
- (149) 6,7,8,9-tetrahydro-2-methyl-1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
- (150) 2-ethyl-6,7,8,9-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
- (151) 6,7,8,9-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]-2-n-propyl-1H-imidazo[4,5-c]quinoline-4-amine
- (152) 2-n-butyl-6,7,8,9-tetrahydro-1-[2-[4-(methylamino)

phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
 (153) 2-cyclopropylmethyl-6,7,8,9-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
 (154) 2-ethoxymethyl-6,7,8,9-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine
 (155) 1,6,7,8-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]cyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (156) 1,6,7,8-tetrahydro-2-methyl-1-[2-[4-(methylamino)phenyl]ethyl]cyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (157) 2-ethyl-1,6,7,8-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]cyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (158) 1,6,7,8-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]-2-n-propylcyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (159) 2-n-butyl-1,6,7,8-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]cyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (160) 2-cyclopropylmethyl-1,6,7,8-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]cyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (161) 2-ethoxymethyl-1,6,7,8-tetrahydro-1-[2-[4-(methylamino)phenyl]ethyl]cyclopenta[b]imidazo[4,5-d]pyridine-4-amine
 (162) 1,6,7,8,9,10-hexahydro-1-[2-[4-(methylamino)phenyl]ethyl]cyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (163) 1,6,7,8,9,10-hexahydro-2-methyl-1-[2-[4-(methylamino)phenyl]ethyl]cyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (164) 2-ethyl-1,6,7,8,9,10-hexahydro-1-[2-[4-(methylamino)phenyl]ethyl]cyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (165) 1,6,7,8,9,10-hexahydro-1-[2-[4-(methylamino)phenyl]ethyl]-2-n-propylcyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (166) 2-n-butyl-1,6,7,8,9,10-hexahydro-1-[2-[4-(methylamino)phenyl]ethyl]cyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (167) 2-cyclopropylmethyl-1,6,7,8,9,10-hexahydro-1-[2-[4-(methylamino)phenyl]ethyl]cyclohepta[b]imidazo[4,5-d]pyridine-4-amine
 (168) 2-ethoxymethyl-1,6,7,8,9,10-hexahydro-1-[2-[4-(methylamino)phenyl]ethyl]cyclohepta[b]imidazo[4,5-d]pyridine-4-amine

The novel 1-(substituted aryl)alkyl-1H-imidazopyridine-4-amine derivatives represented by general formula (I) above according to the invention may be produced by any of various different processes. As the first form of a production process for the invention there may be mentioned the following production process which follows the method disclosed in Japanese Unexamined Patent Publication No. 3-206078, which production process allows synthesis of compounds of general formula (I) wherein R^1 is a group represented by $SO_2NR^3R^4$, $CONR^3R^4$ or $NR^{10}R^{11}$ or a hydroxyl group and R^3 is a hydrogen atom, of which R^{10} is a lower alkyl group or benzyl group and R^{11} is a lower alkyl group, benzyl group, lower alkanesulfonyl group, lower alkanoyl group or a substituted or unsubstituted benzenesulfonyl group.



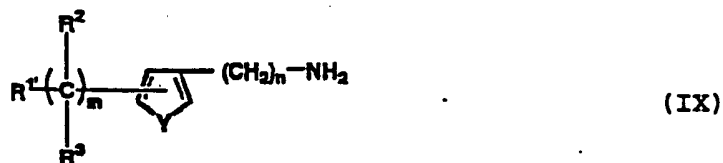
wherein R' is a group represented by SO₂NR'R', CONR'R' or NR¹⁰R'' or a hydroxyl group, when R¹⁰ is a hydrogen atom R'' is a lower alkanesulfonyl group, lower alkanoyl group, lower alkyl group or a substituted or unsubstituted benzenesulfonyl group, when R¹⁰ is a lower alkyl group or benzyl group R'' is a lower alkyl group, benzyl group, lower alkanesulfonyl group, lower alkanoyl group or a substituted or unsubstituted benzenesulfonyl group, and R¹, R², R³, R⁴, R⁵, R⁶, R⁷, m, n, X, Y and the bonds represented by dotted and solid lines are as defined above.

Compounds represented by general formulas (II) and (III) as starting materials in the production process for the invention are known compounds or commercially available compounds, and their production processes are disclosed in Journal of Medicinal Chemistry, Vol.18, p.726 (1975) and elsewhere.

Specifically, in Step 1 a compound represented by general formula (II) may be reacted in the presence or in the absence of a solvent such as acetic acid, using a nitrating agent such as fuming nitric acid at from 0°C to the reflux temperature of the solvent, to obtain a compound of general formula (III).

In Step 2, the compound of general formula (III) may be reacted in the presence or in the absence of an inert solvent such as N,N-dimethylformamide or methylene chloride using a chlorinating agent, for example phosphorus oxychloride, thionyl chloride, phosgene, oxalyl chloride or phosphorus pentachloride at from 0°C to the reflux temperature of the solvent, to obtain a compound of general formula (IV).

In Step 3, an amine represented by the following general formula (IX)



wherein R¹, R², R³, m, n and Y are as defined above, production processes for which are disclosed in Japanese Unexamined Patent Publication No. 2-6461, No. 62-116575, No. 59-48447 and No. 52-85137 and Journal of Medicinal Chemistry,

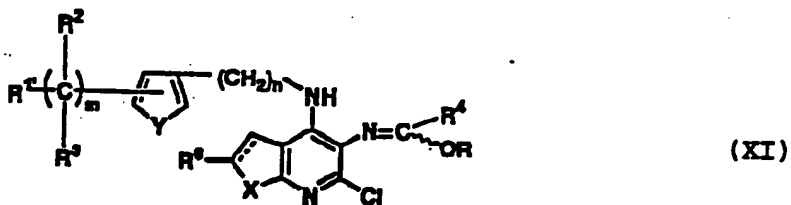
Vol.20, p.1212 (1977), etc., may be reacted with a compound of general formula (IV) in an inert solvent such as N,N-dimethylformamide or methylene chloride in the presence or in the absence of a base such as triethylamine or potassium carbonate at from -10°C to the reflux temperature of the solvent, to obtain a compound of general formula (V).

In Step 4, the nitro group of the compound of general formula (V) may be reduced by an appropriate reduction method, for example a catalytic reduction method using a catalyst such as platinum, Raney nickel, palladium carbon, etc., a reduction method using nickel chloride and sodium borohydride or a reduction method using iron powder and hydrochloric acid, to obtain a compound of general formula (VI).

In Step 5, the compound of general formula (VI) may be reacted with a trialkyl orthoester represented by the following general formula (X)



wherein R represents a lower alkyl group and R⁴ is as defined above, in the presence or in the absence of an acid catalyst such as hydrochloric acid or sulfuric acid and in the presence or in the absence of an inert solvent such as N,N-dimethylformamide or methylene chloride at from 0°C to 200°C, to obtain a compound of general formula (VII) (provided that when R¹ of general formula (VI) is a SO₂NH₂ group, R¹ represents a group SO₂N=C(OR)R⁴ due to the reaction conditions). However, depending on the compound, the reaction sometimes proceeds more slowly from the reaction intermediate between general formula (VI) and general formula (VII) which is represented by the following general formula (XI)



wherein R, R¹, R², R³, R⁴, R⁵, m, n, X and Y are as defined above, and in such cases the resulting intermediate (XI) may be reacted

in the presence or in the absence of an acid catalyst such as p-toluenesulfonic acid and in the presence or in the absence of an inert solvent such as N,N-dimethylformamide, acetonitrile or toluene at from 0°C to 200°C to obtain a compound of general formula (VII).

As an alternative method, the compound of general formula (VI) may be reacted with a compound represented by the following general formula (XII)

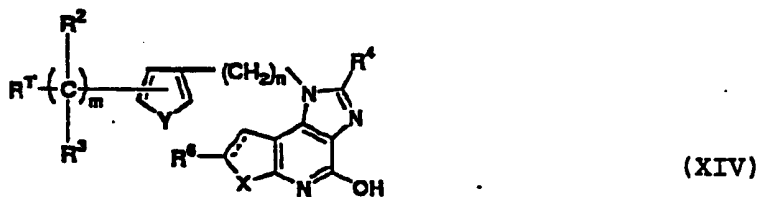


where Z is a chlorine atom or bromine atom, and R^4 is as defined above, in the presence or in the absence of an acid catalyst such as p-toluenesulfonic acid and in the presence or in the absence of an inert solvent such as N,N-dimethylformamide, acetonitrile or toluene at from 0°C to 200°C to obtain a compound of general formula (VII) (provided that when R^1 of general formula (VI) is a hydroxyl group, R^1 represents a group $OCOR^4$).

As another alternative method, the compound of general formula (VI) may be reacted with a compound represented by the following general formula (XIII)



wherein R^4 is as defined above, in the presence or in the absence of an acid catalyst such as hydrochloric acid or sulfuric acid and in the presence or in the absence of an inert solvent such as N,N-dimethylformamide or methylene chloride at from 0°C to 200°C to obtain a compound of the following general formula (XIV)



wherein R^1 represents a group $OCOR^4$ when R^1 of general formula (VI) is a hydroxyl group, and in all other cases R^1 , R^2 , R^3 , R^4 , R^5 , m , n , X and Y are as defined above, after which this compound may be treated with a chlorinating agent to obtain a compound of general formula (VII). For the chlorinating reaction, when R^4 of the compound of general formula (XIV) is a hydrogen atom or a

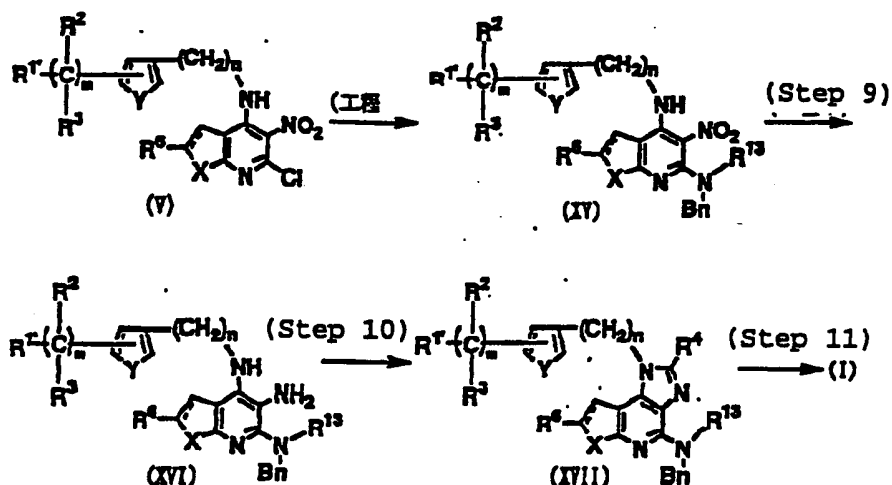
linear or branched alkyl group substituted with a lower alkoxy group, halogen atom or cyclic alkyl group, the compound of general formula (XIV) may be reacted directly with the chlorinating agent, and when R' of the compound of general formula (XIV) is a linear or branched alkyl group with one or more hydroxyl groups, it may be reacted with the chlorinating agent after protecting the hydroxyl group(s) with a protecting group such as acetyl (in which case R' represents a linear or branched alkyl group having one or more hydroxyl groups protected with a protecting group such as acetyl).

For the chlorinating reaction, a suitable chlorinating agent, for example phosphorus oxychloride, thionyl chloride, phosgene, oxalyl chloride or phosphorus pentachloride, etc. may be reacted therewith in the presence or in the absence of an inert solvent such as N,N-dimethylformamide or methylene chloride at from 0°C to the reflux temperature of the solvent, to obtain a compound of general formula (VII) (provided that when R' of general formula (XIV) is a linear or branched alkyl group having one or more hydroxyl groups, R' represents a linear or branched alkyl group having one or more hydroxyl groups protected with a protecting group such as acetyl).

In Step 6, the compound of general formula (VII) and phenol may be reacted with an alkali such as sodium hydroxide or potassium hydroxide in the presence or in the absence of an inert solvent such as N,N-dimethylformamide or methylene chloride at from 0°C to 200°C to obtain a compound of general formula (VIII).

In Step 7, the compound of general formula (VIII) may be reacted with ammonium acetate in the presence or in the absence of an inert solvent such as N,N-dimethylformamide or methylene chloride at from 0°C to 200°C to obtain a compound of general formula (I).

As the second form of the production process there may be mentioned the following production process.



wherein R^1 represents a lower alkyl group or benzyl group, and R^1 , R^2 , R^3 , R^4 , R^5 , m , n , X and Y are as defined above.

Specifically, in Step 8 a compound of general formula (V) obtained by the first form described above and a dibenzylamine or N-lower alkyl-N-benzylamine may be reacted in the presence or in the absence of an inert solvent such as N,N-dimethylformamide or methylene chloride and in the presence or in the absence of a base such as triethylamine or potassium carbonate at from $0^\circ C$ to $200^\circ C$ to obtain a compound of general formula (XV).

In Step 9, the nitro group of the compound of general formula (XV) may be reduced by an appropriate reduction method, for example a reduction method using nickel chloride and sodium borohydride or a reduction method using iron powder and hydrochloric acid, to obtain a compound of general formula (XVI).

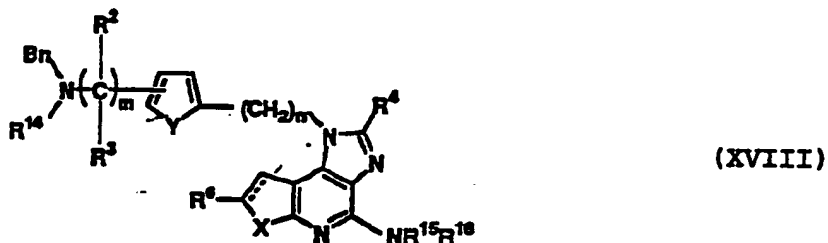
In Step 10, the compound of general formula (XVI) may be reacted with a compound of general formula (X), general formula (XII) or general formula (XIII) in the same manner as step 5 above and under the same conditions, to obtain a compound of general formula (XVII).

In Step 11, the compound of general formula (XVII) may be subjected to debenzylation by an appropriate debenzylating reaction involving, for example, catalytic reduction using a catalyst such as palladium carbon or Perlman's reagent in the presence of a hydrogen donor such as ammonium formate or formic

acid, to obtain a compound of general formula (I).

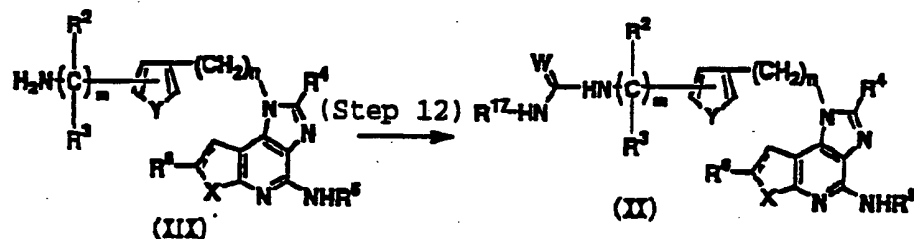
As the third form of the production process there may be mentioned a process of producing a compound of general formula (I) wherein R^1 is a group represented by $NR^{10}R^{11}$ and R^{12} is a hydrogen atom. Specifically, it may be produced by hydrolysis of a compound of general formula (I) that can be obtained by the first form described above wherein R^1 is a group represented by $NR^{10}R^{11}$ and R^{12} is a lower alkanoyl group, in water or an alcoholic solvent such as methanol, ethanol, n-propanol, isopropanol, n-butanol, sec-butanol, tert-butanol, etc. or a mixture of water and an alcohol, using an acid such as hydrochloric acid or sulfuric acid or an alkali such as sodium hydroxide or potassium hydroxide in a range from room temperature to the reflux temperature of the solvent.

The fourth form of the production process relates to a production process for a compound of general formula (I) wherein R^1 is a group represented by $NR^{10}R^{11}$ and either R^{10} and R^{11} is a hydrogen atom while the other is a hydrogen atom or a lower alkyl group. Specifically, a compound represented by the following general formula (XVIII)



where R^{14} represents a lower alkyl group or benzyl group, R^{15} represents a hydrogen atom or benzyl group, R^{16} represents a hydrogen atom, lower alkyl group or benzyl group and R^2 , R^3 , R^4 , R^5 , m , n , X and Y are as defined above, which can be obtained by the first or second form of the production process described above, may be debenzylated by catalytic reduction or the like using a catalyst such as palladium carbon or Perlman's reagent, in the presence of hydrogen or a hydrogen donor such as formic acid or ammonium formate, to obtain a compound of general formula (I).

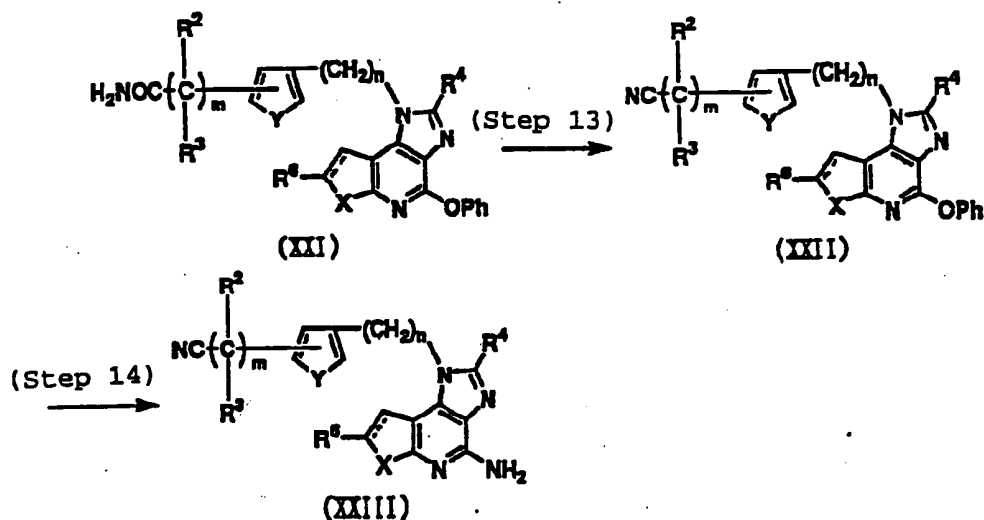
As the fifth form of the production process there may be mentioned the following production process.



wherein R^{17} represents a hydrogen atom or lower alkyl group, W represents an oxygen atom or sulfur atom, and R^1 , R^3 , R^4 , R^5 , R^6 , m, n, X and Y are as defined above.

Specifically, in Step 12 a compound of general formula (XIX) which can be obtained by the third or fourth form of the production process described above may be reacted with an appropriate ureating agent or thioureating agent in the presence or in the absence of an inert solvent such as N,N-dimethylformamide, acetonitrile or toluene at from 0°C to 200°C , to obtain a compound represented by general formula (XX). As examples of appropriate ureating agents there may be mentioned urea, cyanic acid, sodium cyanate, potassium cyanate, urethane, alkylurethane and alkylisocyanate, and as examples of thioureating agents there may be mentioned thiourethane, alkylthiourethane, alkylisothiocyanate, etc.

As the sixth form of the production process there may be mentioned the following production process.

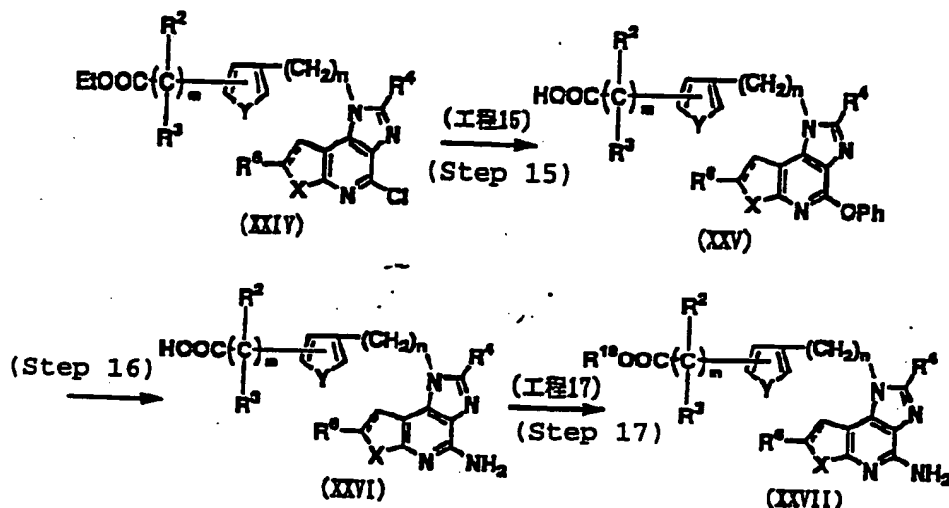


wherein R^1 , R^2 , R^3 , R^4 , m , n , X and Y are as defined above.

Specifically, in Step 13 a compound of general formula (XXI) that can be obtained by the first or second form of the production process described above may be reacted with an appropriate dehydrating agent at from 0°C to 200°C to obtain a compound represented by general formula (XXII). As examples of appropriate dehydrating agents there may be mentioned phosphorus oxychloride, thionyl chloride, diphosphorus pentaoxide, p-toluenesulfonyl chloride, methanesulfonyl chloride, N,N' -dicyclohexylcarbodiimide, acetic anhydride, trifluoroacetic anhydride, etc.

In Step 14, the compound of general formula (XXII) may be reacted by the same method as in Step 7 above to obtain a compound represented by general formula (XXIII).

As the seventh form of the production process there may be mentioned the following production process.

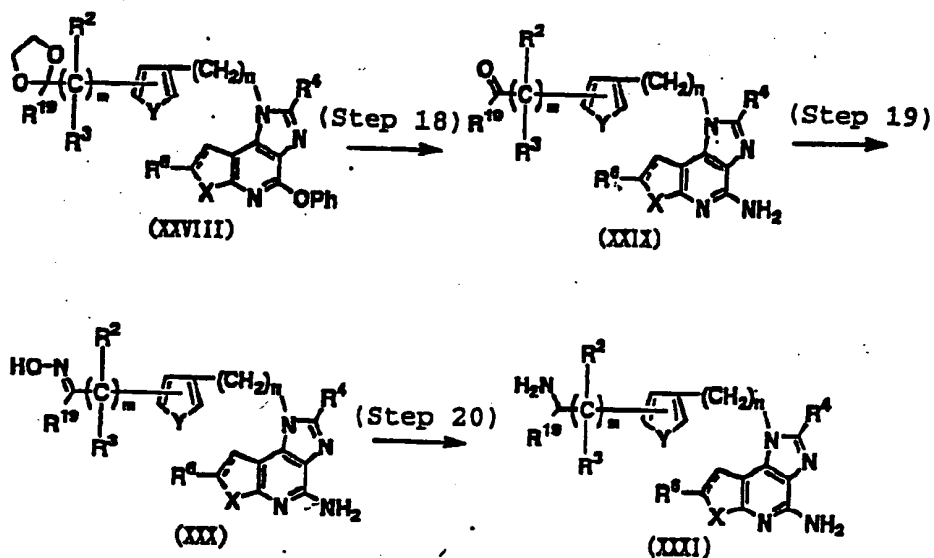


wherein R^{18} represents a lower alkyl group, and R^2 , R^3 , R^4 , R^6 , m , n , X and Y are as defined above.

Specifically, in Step 15 a compound of general formula (XXIV) that can be obtained by the first form of the production process described above may be reacted by the same method as in Step 6 above to obtain a compound represented by general formula (XXV), and in Step 16 the compound of general formula (XXV) may be reacted by the same method as in Step 7 above to obtain a compound represented by general formula (XXVI).

In step 17, the compound of general formula (XXVI) may be reacted with an alcohol such as methanol or ethanol in the presence of an appropriate acid catalyst in a range from room temperature to the reflux temperature of the solvent, to obtain a compound represented by general formula (XXVII). As examples of appropriate acid catalysts there may be mentioned concentrated hydrochloric acid, concentrated sulfuric acid, thionyl chloride and alcoholic hydrogen chloride.

As the eighth form of the production process there may be mentioned the following production process.



wherein R^{19} represents a lower alkyl group, and R^2 , R^3 , R^4 , R^6 , m , n , X and Y are as defined above.

Specifically, in Step 18 a compound of general formula (XXVIII) that can be obtained by the first form of the production process described above may be reacted by the same method as in Step 7 above to obtain a compound represented by general formula (XXIX).

In Step 19, the compound of general formula (XXIX) and hydroxylamine hydrochloride are reacted in the presence or in the absence of a base such as sodium acetate, triethylamine, potassium carbonate, etc. and in the presence or in the absence of an inert solvent such as N,N -dimethylformamide, an alcohol

such as methanol, ethanol, etc. or methylene chloride in a range from 0°C to 200°C, to obtain a compound represented by general formula (XXX).

In Step 20, the oxime group of the compound of general formula (XXX) may be reduced by catalytic reduction using an appropriate catalyst, to obtain a compound represented by general formula (XXXI). As examples of appropriate catalysts there may be mentioned platinum, Raney nickel, palladium carbon, etc., and the reaction may be carried out in a solvent of water or an alcoholic solvent such as methanol, ethanol, etc. or a mixture of water and an alcoholic solvent, in the presence or in the absence of ammonia water or ammonia gas under temperature conditions of from room temperature to 200°C and in a pressure range of from normal pressure to 100 atmospheres.

A medicinal agent having as an effective component a novel 1-(substituted aryl)alkyl-1H-imidazopyridine-4-amine derivative represented by general formula (I) above produced in this fashion, or a pharmacologically acceptable salt thereof, is usually administered in the form of an oral preparation such as capsules, tablets, fine particles, granules, powder, syrup, etc. or a parenteral preparation such as an injection, suppository, eye drops, eye ointment, ear drops, external application, etc. These preparations can be produced by common methods with addition of pharmacologically and pharmaceutically acceptable additives. Specifically, for oral preparations and suppositories there may be used formulating components such as excipients (lactose, D-mannitol, corn starch, crystalline cellulose, etc.), disintegrating agents (carboxymethyl cellulose, carboxymethyl cellulose calcium, etc.), binding agents (hydroxypropyl cellulose, hydroxypropylmethyl cellulose, polyvinylpyrrolidone, etc.), lubricating agents (magnesium stearate, talc, etc.), coating agents (hydroxypropylmethyl cellulose, white sugar, titanium oxide, etc.) and bases (polyethylene glycol, hard fat, etc.); for injections or eye drops and ear drops there may be used formulating components such as dissolving agents or dissolving aids which are either aqueous or can form preparations that dissolve upon use

(distilled water for injection, physiological saline, propylene glycol, etc.), pH regulators (inorganic or organic acids or bases), isotonizing agents (salt, glucose, glycerin, etc.) and stabilizers; and for eye ointments and external preparations there may be used appropriate formulating components such as ointments, creams and tackifiers (white vaseline, macrogol, glycerin, cotton fabric, etc.)

The dosage of the compounds for patients under treatment will depend on the symptoms of the patients, but the daily dosage for adults is usually about 0.1-1000 mg when administered orally and about 0.01-500 mg when administered parenterally.

[Examples]

The present invention will now be explained by way of reference examples and examples which, however, are in no way intended to restrict the invention.

Reference Example 1

2-[4-(methylamino)phenyl]ethylamine·hydrochloride

(1) N-[4-(cyanomethyl)phenyl]formamide

A mixed solution of 71 ml of acetic anhydride and 40 ml of formic acid was stirred at 50°C for 3 minutes, after which 20.0 g of 4-aminobenzyl cyanide was added while stirring on ice, and the mixture was further stirred at room temperature for 30 minutes. A 20% sodium hydroxide, aqueous solution was added to the reaction solution to adjust the liquid to pH 8. After filtering off the precipitated crystals, they were washed with water to obtain 19.0 g of N-[4-(cyanomethyl)phenyl] formamide (melting point: 103.0-105.0°C).

(2) 2-[4-(methylamino)phenyl]ethylamine·hydrochloride

To a suspension of 22.8 g of lithium aluminum hydride and 500 ml of anhydrous tetrahydrofuran under a nitrogen stream there was added dropwise over 30 minutes a mixed solution of 29.5 g of concentrated sulfuric acid and 100 ml of anhydrous tetrahydrofuran, while stirring on ice. After heating the mixture to room temperature, a solution of 19.3 g of N-[4-(cyanomethyl)phenyl]formamide in 400 ml of anhydrous tetrahydrofuran was added dropwise over one hour. After

stirring at room temperature for one hour, a mixed solution of 60 ml of water and 120 ml of tetrahydrofuran was added dropwise. After adding 9.5 g of potassium carbonate, the mixture was stirred at room temperature for 14 hours. The insoluble portion was filtered off and washed with tetrahydrofuran and methylene chloride. The filtrate was dried, and then ethanolic hydrogen chloride was added to adjust the liquid to pH 2. The precipitated crystals were filtered off and washed with tetrahydrofuran to obtain 18.9 g of light brown crystals. Recrystallization from ethanol yielded light brown crystals with a melting point of 215.0-220.0°C.

Elemental analysis: $C_{14}H_{16}N_2 \cdot 2HCl$

Calculated: C, 48.44; H, 7.23; N, 12.55

Found: C, 48.39; H, 7.29; N, 12.59

Reference Example 2

2-[4-(2-aminoethyl)phenyl]-2-methyl-1,3-dioxolane

(1) N-[2-[4-(2-methyl-1,3-dioxolan-2-yl)phenyl]ethyl] trifluoroacetamide

After dissolving 10.0 g of N-[2-(4-acetylphenyl)ethyl] trifluoroacetamide in 100 ml of toluene, 12.0 g of ethylene glycol and 0.4 g of p-toluenesulfonic acid·1H₂O were added and the mixture was refluxed for 15 hours using a Dean Stark apparatus. After cooling the reaction solution, it was washed with water and dewatered, and then the solvent was distilled off under reduced pressure to obtain 11.0 g of N-[2-[4-(2-methyl-1,3-dioxolan-2-yl)phenyl]ethyl] trifluoroacetamide (melting point: 72.0-74.0°C).

(2) 2-[4-(2-aminoethyl)phenyl]-2-methyl-1,3-dioxolane

After dissolving 11.0 g of N-[2-[4-(2-methyl-1,3-dioxolan-2-yl)phenyl]ethyl] trifluoroacetamide in 30 ml of methanol, 20 ml of a 10% sodium hydroxide aqueous solution was added and the mixture was stirred at room temperature for 2 hours. After concentrating the reaction solution under reduced pressure, it was extracted with a mixed solution of methylene chloride and methanol (10:1) and dried, and then the solvent was distilled off under reduced pressure to obtain 7.20 g of a brown liquid.

Mass spectrum m/z: 207 (M⁺)

NMR spectrum δ (CDCl₃) ppm: 1.65(3H, s), 2.74(2H, t, J=6.5Hz), 2.97-3.00(2H, m), 3.79(2H, t, J=2Hz), 4.03(2H, t, J=2Hz), 7.18(2H, d, J=8Hz), 7.41(2H, d, J=8Hz)

Reference Example 3

N-[1-[4-(2-aminoethyl)phenyl]ethyl] acetamide·hydrochloride

(1) N-[1-[4-[2-(tert-butoxycarbonylamino)ethyl]phenyl]ethyl] acetamide

To 10.0 g of [4-[2-(tert-butoxycarbonylamino)ethyl] acetophenone there were added 100 ml of 10% methanolic ammonia and 1 ml of Raney nickel, and the mixture was stirred for 48 hours under a hydrogen atmosphere at 60°C, 80 atmospheres. After cooling the reaction solution, the catalyst was distilled off and the solution was concentrated under reduced pressure. The resulting green liquid was dissolved in 70 ml of methylene chloride, and then 5.8 ml of triethylamine and 3.9 ml of acetic anhydride were added while stirring on ice, and stirring was continued for 30 minutes. After adding water and extracting with methylene chloride, the solution was dried and concentrated under reduced pressure. The residue was washed with diethyl ether to obtain 9.30 g of N-[1-[4-[2-(tert-butoxycarbonylamino)ethyl]phenyl]ethyl] acetamide (melting point: 138.0-140.0°C).

(2) N-[1-[4-(2-aminoethyl)phenyl]ethyl] acetamide·hydrochloride

After dissolving 9.00 g of N-[1-[4-[2-(tert-butoxycarbonylamino)ethyl]phenyl]ethyl] acetamide in 18 ml of methanol, 27 ml of 15% ethyl acetate-containing hydrogen chloride was added and the mixture was stirred at room temperature one hour. After concentrating the reaction solution under reduced pressure, 10 ml of isopropyl alcohol was added, the mixture was stirred on ice, and the precipitated crystals were filtered off to obtain 6.0 g of colorless crystals. Recrystallization from ethanol yielded colorless crystals with a melting point of 212.0-214.0°C.

Elemental analysis: C₁₇H₂₁N₂O·HCL

Calculated: C, 59.37; H, 7.89; N, 11.54

Found: C, 59.25; H, 7.61; N, 11.48

Reference Example 4

2-[4-(dibenzylamino)phenyl]ethylamine·hydrochloride

(1) N-[2-[4-(dibenzylamino)phenyl]ethyl] trifluoroacetamide

To 1.00 g of N-[2-(4-aminophenyl)ethyl] trifluoroacetamide there were added 600 mg of potassium carbonate, 10 ml of N,N-dimethylformamide and 1.1 ml of benzyl bromide, and the mixture was stirred at 50°C for one hour. After adding water and extracting with diethyl ether, the solution was dried and concentrated under reduced pressure. The residue was washed with isopropyl ether to obtain 1.10 g of N-[2-[4-(dibenzylamino)phenyl]ethyl] trifluoroacetamide (melting point: 142.0-144.0°C).

(2) 2-[4-(dibenzylamino)phenyl]ethylamine·hydrochloride

To 1.00 g of N-[2-[4-(dibenzylamino)phenyl]ethyl] trifluoroacetamide there were added 3 ml of methanol and 2 ml of a 10% sodium hydroxide aqueous solution, and the mixture was stirred at 60°C for 30 minutes. After concentrating the reaction solution under reduced pressure, water was added and the solution was extracted with methylene chloride and dried. Ethanolic hydrogen chloride was added to the methylene chloride layer, and after stirring on ice the precipitated crystals were filtered off to obtain 1.00 g of colorless crystals. Recrystallization from a mixed solution of methylene chloride and ethanol yielded colorless crystals with a melting point of 168.0-170.0°C.

Elemental analysis: $C_{22}H_{24}N_2 \cdot 2HCl \cdot 1/4H_2O$

Calculated: C, 67.09; H, 6.78; N, 7.11

Found: C, 67.01; H, 6.81; N, 7.23

Reference Example 5

4-(2-aminoethyl)- α -methylbenzyl alcohol·hydrochloride

After dissolving 10.0 g of 4-(2-azidoethyl) acetophenone in 50 ml of methanol, 2.0 g of sodium borohydride was added and the mixture was stirred at room temperature for one hour. After concentrating the reaction solution under reduced pressure, water was added and the solution was extracted with diethyl

ether, dried and then concentrated under reduced pressure. The resulting faint yellow liquid was dissolved in 150 ml of tetrahydrofuran, and after adding 21.7 g of triphenylphosphine and 2.5 ml of water, the mixture was stirred at room temperature for 10 hours. After concentrating the reaction solution under reduced pressure, it was dissolved in 100 ml of ethanol, and then ethanolic hydrogen chloride was added prior to stirring on ice. The precipitated crystals were filtered off to obtain 9.00 g of colorless crystals. Recrystallization from ethanol yielded colorless crystals with a melting point of 171.0-172.0°C.

Elemental analysis: $C_{10}H_{11}NO \cdot HCl$

Calculated: C, 59.55; H, 8.00; N, 6.94

Found: C, 59.29; H, 8.27; N, 6.85

Reference Example 6

4-(3-aminopropyl)benzenesulfonamide·hydrochloride

(1) N-(3-phenylpropyl)acetamide

To a solution of 1.00 g of 3-phenylpropylamine in 25 ml of pyridine there was added dropwise 3.8 ml of acetic anhydride while cooling on ice, and then the mixture was stirred at room temperature for one hour. The solvent was distilled off under reduced pressure, ethyl acetate and 10% hydrochloric acid were added to the residue, and after adjusting the liquid to pH 3-4 it was separated. After washing the organic layer with water and then with saturated saline and dewatering, the solvent was distilled off under reduced pressure to obtain 6.20 g of N-(3-phenylpropyl)acetamide.

(2) 4-[3-(acetylamino)propyl]benzenesulfonyl chloride

To a solution of 1.00 g of N-(3-phenylpropyl)acetamide in 10 ml of methylene chloride there was added dropwise 3.40 g of chlorosulfonic acid while cooling on ice, after which the mixture was refluxed for one hour. The reaction mixture was poured into ice water, and the separated organic layer was washed with saturated saline. After dewatering the organic layer, the solvent was distilled off under reduced pressure to obtain 1.20 g of 4-[3-(acetylamino)propyl]benzenesulfonyl chloride.

(3) 4-[3-(acetylamino)propyl]benzenesulfonamide

A mixture of 1.20 g of 4-[3-(acetylamino)propyl]

benzenesulfonyl chloride, 6 ml of tetrahydrofuran and 3.0 g of ammonia water was stirred at room temperature for 7 hours. After distilling off the solvent under reduced pressure and adding methanol to the residue, the insoluble portion was filtered off. The filtrate was concentrated to obtain 0.50 g of 4-[3-(acetylamino)propyl]benzenesulfonamide.

(4) 4-(3-aminopropyl)benzenesulfonamide·hydrochloride

A mixture of 1.95 g of 4-[3-(acetylamino)propyl]benzenesulfonamide and 20 ml of 6 N hydrochloric acid was stirred at 110-120°C for 6 hours. The reaction mixture was concentrated under reduced pressure, and the residue was washed with ethanol to obtain 0.95 g of colorless crystals.

NMR spectrum δ (DMSO) ppm: 1.89 (2H, quint, $J=8\text{Hz}$), 2.74 (2H, t, $J=8\text{Hz}$), 2.80 (2H, t, $J=8\text{Hz}$), 7.20 (2H, br-s), 7.40 (2H, d, $J=8.5\text{Hz}$), 7.76 (2H, d, $J=8.5\text{Hz}$), 7.93 (2H, br-s)

Reference Example 7

N-[4-(2-aminoethyl)phenyl]-4-methylbenzenesulfonamide

(1) N-[2-(4-nitrophenyl)ethyl] trifluoroacetamide

To a mixture of 5.00 g of 2-(4-nitrophenyl)ethylamine·hydrochloride and 50 ml of methylene chloride there were added 3.4 ml of triethylamine and 10.5 ml of trifluoroacetic anhydride while cooling on ice, and the mixture was stirred at room temperature for 30 minutes. After concentrating the reaction mixture under reduced pressure and adding water to the residue, extraction was performed with methylene chloride. After washing the extract with saturated saline and dewatering, the solvent was distilled off under reduced pressure to obtain 8.50 g of N-[2-(4-nitrophenyl)ethyl] trifluoroacetamide.

(2) N-[2-(4-aminophenyl)ethyl] trifluoroacetamide

After dissolving 36.3 g of N-[2-(4-nitrophenyl)ethyl] trifluoroacetamide in 180 ml of methanol, 1.8 g of 5% palladium-carbon was added and the solution was subjected to catalytic reduction at normal temperature and normal pressure for 17 hours. The catalyst was filtered off, and the filtrate was concentrated under reduced pressure to obtain 33.4 g of N-[2-(4-aminophenyl)ethyl] trifluoroacetamide.

(3) N-[4-[2-(trifluoroacetyl-amino)ethyl]phenyl]-4-methylbenzenesulfonamide

To a mixture of 10.0 g of N-[2-(4-aminophenyl)ethyl]trifluoroacetamide, 50 ml of methylene chloride and 7.9 ml of triethylamine there was added dropwise a 10-ml solution of methylene chloride containing 10.8 g of p-toluenesulfonyl chloride while stirring on ice, and the stirring was continued for one hour. Water was added to the reaction mixture, and the precipitated crystals were filtered off to obtain 10.7 g of N-[4-[2-(trifluoroacetyl-amino)ethyl]phenyl]-4-methylbenzenesulfonamide.

(4) N-[4-(2-aminoethyl)phenyl]-4-methylbenzenesulfonamide

A mixture of 13.4 g of N-[4-[2-(trifluoroacetyl-amino)ethyl]phenyl]-4-methylbenzenesulfonamide, 130 ml of methanol and 80 ml of a 10% sodium hydroxide aqueous solution was stirred at room temperature for 30 minutes. After adding 10% hydrochloric acid to the reaction mixture to adjust the liquid to pH 7, it was concentrated under reduced pressure. After adding ethanol to the residue and filtering off the insoluble portion, the filtrate was concentrated under reduced pressure to obtain 12.0 g of a light yellow liquid.

NMR spectrum δ (DMSO) ppm: 2.33(3H, s), 2.76(2H, t, J=8.5Hz), 2.96(2H, t, J=8.5Hz), 7.05(2H, d, J=8.5Hz), 7.10(2H, d, J=8.5Hz), 7.34(2H, d, J=8Hz), 7.65(2H, d, J=8Hz), 8.40(2H, br-s)

Reference Example 8

4-(2-aminoethyl)-N-methylbenzenesulfonamide-hydrochloride

(1) N-(2-phenylethyl)acetamide

To a solution of 15.0 g of 2-phenylethylamine in 75 ml of pyridine there was added dropwise 12.8 ml of acetic anhydride while cooling on ice, and the mixture was stirred at room temperature for one hour. After concentrating the reaction mixture under reduced pressure and adding 10% hydrochloric acid to the residue to adjust the liquid to pH 3-4, extraction was performed with ethyl acetate. The extract was washed with water and then with saturated saline and dewatered, and the solvent was distilled off under reduced pressure to obtain 27.7 g of N-

(2-phenylethyl)acetamide.

(2) 4-[2-(acetylamino)ethyl]benzenesulfonyl chloride

To a mixed solution of 98.2 g of N-(2-phenylethyl)acetamide and 500 ml of methylene chloride there was added dropwise 362 g of chlorosulfonic acid while cooling on ice. After refluxing for 2 hours, the reaction solution was poured into ice water. The precipitated crystals were filtered off and then washed with water to obtain 88.3 g of 4-[2-(acetylamino)ethyl]benzenesulfonyl chloride.

(3) 4-[2-(acetylamino)ethyl]-N-methylbenzenesulfonamide

To a solution of 5.00 g of 4-[2-(acetylamino)ethyl]benzenesulfonyl chloride in 25 ml of tetrahydrofuran there was added at room temperature 14.8 g of a 40% methylamine aqueous solution. After refluxing for 5 hours, the mixture was concentrated under reduced pressure to obtain 5.90 g of 4-[2-(acetylamino)ethyl]-N-methylbenzenesulfonamide.

(4) 4-(2-aminoethyl)-N-methylbenzenesulfonamide·hydrochloride

A mixture of 34.0 g of 4-[2-(acetylamino)ethyl]-N-methylbenzenesulfonamide and 170 ml of 6 N hydrochloric acid was stirred at 110°C for 5 hours. The reaction mixture was concentrated under reduced pressure and the residue was washed with methanol to obtain 10.6 g of colorless crystals.

NMR spectrum δ (DMSO) ppm: 2.42 (3H, s), 3.02 (2H, t, J=5Hz), 3.07 (2H, t, J=5Hz), 7.40 (1H, br-s), 7.57 (2H, d, J=8Hz), 7.74 (2H, d, J=8Hz), 8.08 (2H, br-s)

Reference Example 9

4-(2-aminoethyl)-N-propylbenzenesulfonamide

(1) N-propyl-4-[2-(trifluoroacetylamino)ethyl]benzenesulfonamide

To a solution of 13.4 g of 4-[2-(trifluoroacetylamino)ethyl]benzenesulfonyl chloride in 20 ml of tetrahydrofuran there was added 6.9 ml of propylamine while cooling on ice, and the mixture was stirred on ice for 3 hours. The reaction mixture was concentrated under reduced pressure, and water and methylene chloride were added to the residue. The precipitated crystals were filtered off to obtain 15.3 g of N-propyl-4-[2-

(trifluoroacetylamino)ethyl]benzenesulfonamide.

(2) 4-(2-aminoethyl)-N-propylbenzenesulfonamide

To a solution of 15.3 g of N-propyl-4-[2-(trifluoroacetylamino)ethyl]benzenesulfonamide in 150 ml of methanol there was added at room temperature 92 ml of a 10% sodium hydroxide aqueous solution, and the mixture was stirred for 30 minutes. After adding 10% hydrochloric acid to the reaction mixture to adjust the liquid to pH 7-8, it was concentrated under reduced pressure. After adding ethanol to the residue and filtering off the insoluble portion, the filtrate was concentrated under reduced pressure to obtain 12.7 g of a colorless liquid.

NMR spectrum δ (DMSO) ppm: 0.80(3H, t, J=7Hz), 1.40(2H, sextet, J=7Hz), 2.70(2H, t, J=7Hz), 2.97(2H, t, J=7.5Hz), 3.09(2H, t, J=7.5Hz), 4.23(1H, br-s), 7.46(2H, d, J=8Hz), 7.74(2H, d, J=8Hz), 7.80-8.00(2H, br-s)

Reference Example 10

4-(2-aminoethyl)-N, N-dimethylbenzenesulfonamide·hydrochloride

(1) 4-[2-(acetylamino)ethyl]-N,N-dimethylbenzenesulfonamide

To a solution of 5.00 g of 4-[2-(acetylamino)ethyl]benzenesulfonyl chloride in 25 ml of tetrahydrofuran there was added at room temperature 17.2 g of a 50% dimethylamine aqueous solution, and the mixture was refluxed for 5 hours. The reaction mixture was concentrated under reduced pressure to obtain 4.10 g of 4-[2-(acetylamino)ethyl]-N,N-dimethylbenzenesulfonamide.

(2) 4-(2-aminoethyl)-N,N-dimethylbenzenesulfonamide·hydrochloride

A mixture of 4.10 g of 4-[2-(acetylamino)ethyl]-N,N-dimethylbenzenesulfonamide and 40 ml of 6 N hydrochloric acid was stirred at 100°C for 6 hours. The reaction mixture was concentrated under reduced pressure and the residue was washed with methanol to obtain 1.00 g of colorless crystals.

NMR spectrum δ (DMSO) ppm: 2.62(6H, s), 3.01(2H, t, J=8.5Hz), 3.11(2H, t, J=8.5Hz), 7.54(2H, d, J=8Hz), 7.70(2H, d, J=8Hz), 8.00(2H, br-s)

Reference Example 11

2-(2-aminoethyl)benzenesulfonamide

(1) 5-bromo-2-[2-(trifluoroacetylamino)ethyl]benzenesulfonyl chloride

To a solution of 15.5 g of N-[2-(4-bromophenyl)ethyl]trifluoroacetamide in 45 ml of methylene chloride there was added 10 ml of chlorosulfonic acid while cooling on ice, and the mixture was refluxed for two days. After pouring the reaction mixture into ice water for separation, the organic layer was washed first with water and then with saturated saline. After dewatering the organic layer, the solvent was distilled off under reduced pressure. A mixture of n-hexane and ethyl acetate (6:1) was added to the residue, and the insoluble portion was filtered off. After concentrating the filtrate under reduced pressure, the residue was purified by column chromatography [silica gel, n-hexane/ethyl acetate (6:1)] to obtain 4.90 g of 5-bromo-2-[2-(trifluoroacetylamino)ethyl]benzenesulfonyl chloride.

(2) 5-bromo-2-[2-(trifluoroacetylamino)ethyl]benzenesulfonamide

To a solution of 25.5 g of 5-bromo-2-[2-(trifluoroacetylamino)ethyl]benzenesulfonyl chloride in 38 ml of tetrahydrofuran there was added 45 ml of ammonia water while cooling on ice, and the mixture was stirred at room temperature for one hour. The reaction mixture was concentrated under reduced pressure, and the residue was washed with methylene chloride to obtain 22.0 g of 5-bromo-2-[2-(trifluoroacetylamino)ethyl]benzenesulfonamide.

(3) 2-[2-(trifluoroacetylamino)ethyl]benzenesulfonamide

A mixture of 12.0 g of 5-bromo-2-[2-(trifluoroacetylamino)ethyl]benzenesulfonamide, 120 ml of methanol and 1.2 g of 10% palladium-carbon was subjected to catalytic reduction at normal temperature and normal pressure for 4 hours. After filtering off the catalyst, the filtrate was concentrated under reduced pressure to obtain 11.0 g of 2-[2-(trifluoroacetylamino)ethyl]benzenesulfonamide.

(4) 2-(2-aminoethyl)benzenesulfonamide

A mixture of 11.0 g of 2-[2-(trifluoroacetylamino)ethyl]

benzenesulfonamide, 110 ml of methanol and 66 ml of a 10% sodium hydroxide aqueous solution was stirred at room temperature for one hour. After adding 10% hydrochloric acid to the reaction mixture to adjust the liquid to pH 7-8, it was concentrated under reduced pressure. After adding ethanol to the residue and filtering off the insoluble portion, the filtrate was distilled off under reduced pressure to obtain 8.0 g of colorless crystals. NMR spectrum δ (DMSO) ppm: 3.10(2H, t, J=7Hz), 3.30(2H, t, J=7Hz), 7.43-7.47(2H, m), 7.50-7.60(5H, m), 7.90-7.93(1H, m)

Reference Example 12

3-(2-aminoethyl)benzenesulfonamide

(1) N-[2-(4-bromophenyl)ethyl]trifluoroacetamide

To a solution of 10.0 g of 2-(4-bromophenyl)ethylamine in 100 ml of methylene chloride there was added 21 ml of trifluoroacetic anhydride while cooling on ice, and the mixture was stirred at room temperature for 30 minutes. The reaction mixture was concentrated under reduced pressure and the residue was washed with isopropyl ether to obtain 13.7 g of N-[2-(4-bromophenyl)ethyl]trifluoroacetamide.

(2) 2-bromo-5-[2-(trifluoroacetylamino)ethyl] benzenesulfonyl chloride

To a solution of 15.3 g of N-[2-(4-bromophenyl)ethyl]trifluoroacetamide in 45 ml of methylene chloride there was added 10 ml of chlorosulfonic acid while cooling on ice, and the mixture was refluxed for two days. After pouring the reaction mixture into ice water for separation, the organic layer was washed first with water and then with saturated saline. After dewatering the organic layer, the solvent was distilled off under reduced pressure. The residue was washed with a mixed solution of n-hexane and ethyl acetate (6:1) to obtain 8.20 g of 2-bromo-5-[2-(trifluoroacetylamino)ethyl]benzenesulfonyl chloride.

(3) 2-bromo-5-[2-(trifluoroacetylamino)ethyl]benzenesulfonamide

To a solution of 8.20 g of 2-bromo-5-[2-(trifluoroacetylamino)ethyl]benzenesulfonyl chloride in 12 ml of tetrahydrofuran there was added 14.4 ml of ammonia water while

cooling on ice, and the mixture was stirred at room temperature for one hour. The reaction mixture was concentrated under reduced pressure, and the residue was washed with ethanol to obtain 5.30 g of 2-bromo-5-[2-(trifluoroacetylamino)ethyl] benzenesulfonamide.

(4) 3-[2-(trifluoroacetylamino)ethyl]benzenesulfonamide

A mixture of 5.30 g of 2-bromo-5-[2-(trifluoroacetylamino)ethyl]benzenesulfonamide, 50 ml of methanol and 0.5 g of 10% palladium-carbon was subjected to catalytic reduction at normal temperature and normal pressure for 11 hours. After filtering off the catalyst, the filtrate was concentrated under reduced pressure to obtain 4.00 g of 3-[2-(trifluoroacetylamino)ethyl] benzenesulfonamide.

(5) 3-(2-aminoethyl)benzenesulfonamide

A mixture of 4.00 g of 3-[2-(trifluoroacetylamino)ethyl] benzenesulfonamide, 40 ml of methanol and 24 ml of a 10% sodium hydroxide aqueous solution was stirred at room temperature for 3 hours. After adding 10% hydrochloric acid to the reaction mixture to adjust the liquid to pH 7-8, it was concentrated under reduced pressure. After adding ethanol to the residue and filtering off the insoluble portion, the filtrate was concentrated under reduced pressure to obtain 4.30 g of colorless crystals.

NMR spectrum δ (DMSO) ppm: 2.98(2H, t, J=8Hz), 3.08(2H, t, J=8Hz), 7.25(2H, br-s), 7.48-7.58(2H, m), 7.70-7.78(2H, m), 7.81(2H, br-s)

Reference Example 13

4-[2-[(2-chloro-3-nitroquinolin-4-yl)amino]ethyl]benzamide

To a solution of 8.03 g of 2,4-dichloro-3-nitroquinoline and 18.5 ml of triethylamine in N,N-dimethylformamide there was added 4.35 g of 4-(2-aminoethyl)benzamide while stirring on ice, and the mixture was further stirred on ice for 5 hours. After adding water and 10% hydrochloric acid to the reaction solution to adjust the liquid to pH 8, extraction was performed with ethyl acetate. The organic layer was washed with saturated saline and then dewatered, and the solvent was distilled off

under reduced pressure. The residue was washed with isopropyl ether to obtain 5.89 g of brown crystals. Recrystallization from ethanol yielded yellowish brown prism crystals with a melting point of 217.5-218.5°C.

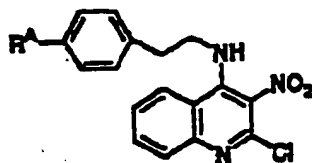
Elemental analysis: $C_{11}H_{13}ClN_2O_2$

Calculated: C, 58.31; H, 4.08; N, 15.11

Found: C, 58.32; H, 3.88; N, 15.04

The compounds for Reference Examples 14-46 listed in Tables 1 to 9 were obtained according to the method of Reference Example 13.

Table 1




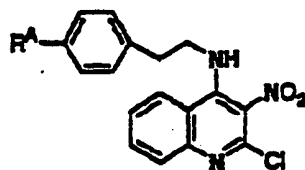
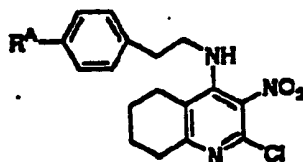
| | R ^a | Properties (recrystallization solvent) | Elemental analysis |
|---------------|---|---|---|
| Ref. Ex.14 | CONHMe | yellowish brown crystals (EtOH) mp: 194.0-196.0°C | C ₁₇ H ₁₁ ClN ₂ O Calc.: C, 59.30; H, 4.45; N, 14.56 Found: C, 59.30; H, 4.59; N, 14.29 |
| Ref. Ex.15 | OH | yellowish brown crystals (AcOEt) mp: 140.0-145.0°C, decomposition | C ₁₇ H ₁₁ ClN ₂ O Calc.: C, 59.40; H, 4.10; N, 12.22 Found: C, 59.32; H, 3.83; N, 12.20 |
| Ref. Ex.16 | CO ₂ Et | orange needle-like crystals (EtOH) mp: 122.0-124.0°C | C ₁₉ H ₁₃ ClN ₂ O Calc.: C, 60.08; H, 4.54; N, 10.51 Found: C, 60.15; H, 4.32; N, 10.56 |
| Ref. Ex.17 |  | yellow crystals (Et ₂ O) mp: 122.5-123.0°C | C ₁₇ H ₁₁ ClN ₂ O Calc.: C, 60.95; H, 4.87; N, 10.15 Found: C, 60.83; H, 4.77; N, 10.19 |
| Ref. Ex.18 | SO ₂ NH ₂ | yellow crystals (DMF-H ₂ O) mp: 199.5-201.5°C | C ₁₇ H ₁₁ ClN ₂ O ₂ S Calc.: C, 50.19; H, 3.72; N, 13.77 Found: C, 49.99; H, 3.56; N, 13.48 |
| Ref. Ex.19 | SO ₂ NHMe | yellow needle-like crystals (CH ₃ CN) mp: 178.0-179.0°C | C ₁₈ H ₁₂ ClN ₂ O ₂ S Calc.: C, 51.37; H, 4.07; N, 13.31 Found: C, 51.46; H, 3.96; N, 13.47 |
| Ref. Ex.20 | SO ₂ NH ₂ Et | light yellow needle- like crystals (EtOH) mp: 183.0-184.5°C | C ₁₉ H ₁₃ ClN ₂ O ₂ S Calc.: C, 52.47; H, 4.40; N, 12.88 Found: C, 52.78; H, 4.34; N, 12.77 |
| Ref. Ex.21 | SO ₂ NH-n-Pr | brown needle-like crystals (iso-PrOH) mp: 136.0-137.5°C | C ₂₀ H ₁₅ ClN ₂ O ₂ S Calc.: C, 53.51; H, 4.71; N, 12.48 Found: C, 53.80; H, 4.70; N, 12.63 |
| Ref. Ex.22 | SO ₂ NMe ₂ | yellow needle-like crystals (CH ₃ CN) mp: 162.0-163.0°C | C ₁₈ H ₁₂ ClN ₂ O ₂ S Calc.: C, 52.47; H, 4.40; N, 12.88 Found: C, 52.57; H, 4.30; N, 13.13 |
| Ref. Ex.23 | CH ₃ OH | yellow crystals (iso-PrOH) mp: 169.0-171.0°C | C ₁₇ H ₁₁ ClN ₂ O Calc.: C, 60.42; H, 4.51; N, 11.74 Found: C, 60.72; H, 4.23; N, 11.71 |
| Ref. Ex.24 | NHMe | yellow crystals (DMF-H ₂ O) mp: 210.5-213.0°C | C ₁₇ H ₁₁ ClN ₂ O ₂ S Calc.: C, 51.37; H, 4.07; N, 13.31 Found: C, 51.39; H, 4.02; N, 13.14 |
| Ref. Ex.25 | NHAc | yellow crystals (EtOH) mp: 190.0-191.5°C | C ₁₇ H ₁₁ ClN ₂ O Calc.: C, 59.30; H, 4.45; N, 14.56 Found: C, 59.28; H, 4.37; N, 14.59 |

Table 2



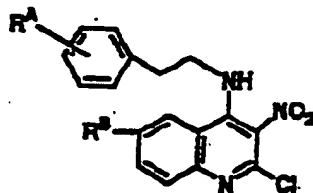
| | R ¹ | Properties (recrystallization solvent) | Elemental analysis |
|---------------|----------------|---|---|
| Ref. Ex.26 | NHMe | yellow prism crystals (AcOEt) mp: 146.5-147.5°C | C ₁₇ H ₁₁ ClN ₂ O ₂ Calc.: C, 60.59; H, 4.80; N, 15.70 Found: C, 60.75; H, 4.69; N, 15.66 |
| Ref. Ex.27 | CHMeNHAc | yellow crystals (AcOEt) mp: 192.5-194.0°C | C ₁₉ H ₁₃ ClN ₂ O ₃ Calc.: C, 61.09; H, 5.13; N, 13.57 Found: C, 61.06; H, 5.22; N, 13.37 |

Table 3



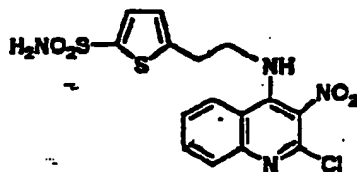
| | R ¹ | Properties (recrystallization solvent) | Elemental analysis |
|---------------|---------------------------------|---|---|
| Ref. Ex.28 | SO ₂ NH ₂ | yellow crystals (MeOH) mp: 194.0-196.0°C | C ₁₇ H ₁₁ ClN ₂ O ₂ S Calc.: C, 49.69; H, 4.66; N, 13.64 Found: C, 49.55; H, 4.76; N, 13.52 |
| Ref. Ex.29 | CH ₂ OH | yellow crystals (iso-PrOH) mp: 149.5-151.0°C | C ₁₇ H ₁₃ ClN ₂ O ₂ Calc.: C, 59.75; H, 5.57; N, 11.61 Found: C, 59.65; H, 5.38; N, 11.53 |
| Ref. Ex.30 | NHMs | yellow crystals (AcOEt-iso-Pr ₂ O) mp: 176.5-177.5°C | C ₁₉ H ₁₃ ClN ₂ O ₂ S Calc.: C, 50.88; H, 4.98; N, 13.19 Found: C, 50.89; H, 4.97; N, 13.04 |
| Ref. Ex.31 | NHAc | yellow prism crystals (AcOEt) mp: 187.5-188.5°C | C ₁₇ H ₁₁ ClN ₂ O ₂ Calc.: C, 58.69; H, 5.44; N, 14.41 Found: C, 58.64; H, 5.45; N, 14.30 |
| Ref. Ex.32 | NHMe | yellowish brown needle-like crystals (AcOEt) mp: 146.5-148.0°C | C ₁₇ H ₁₁ ClN ₂ O ₂ Calc.: C, 59.91; H, 5.87; N, 15.53 Found: C, 59.86; H, 5.73; N, 15.59 |
| Ref. Ex.33 | CHMeNHAc | yellow crystals (AcOEt) mp: 170.0-174.0°C | C ₁₉ H ₁₃ ClN ₂ O ₃ Calc.: C, 60.50; H, 6.04; N, 13.44 Found: C, 60.39; H, 6.10; N, 13.24 |

Table 4



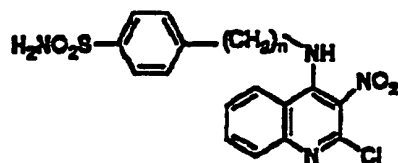
| | R ¹ | R ² | Properties (recrystallization solvent) | Elemental analysis |
|---------------|-----------------------------------|----------------|---|---|
| Ref. Ex.34 | o-SO ₂ NH ₂ | H | yellow needle-like crystals (CH ₂ CN) mp: 232.0-233.0°C | C ₁₇ H ₁₃ ClN ₂ O ₂ S Calc.: C, 50.19; H, 3.72; N, 13.77 Found: C, 50.19; H, 3.55; N, 13.72 |
| Ref. Ex.35 | m-SO ₂ NH ₂ | H | yellowish brown crystals (CH ₂ CN) mp: 225.5-226.5°C | C ₁₇ H ₁₃ ClN ₂ O ₂ S Calc.: C, 50.19; H, 3.72; N, 13.77 Found: C, 50.11; H, 3.55; N, 13.59 |
| Ref. Ex.36 | p-SO ₂ NH ₂ | Me | yellowish brown crystals (EtOH) mp: 235.5-237.0°C | C ₁₈ H ₁₅ ClN ₂ O ₂ S Calc.: C, 51.37; H, 4.07; N, 13.31 Found: C, 51.49; H, 4.07; N, 13.03 |
| Ref. Ex.37 | p-SO ₂ NH ₂ | OMe | yellowish brown needle-like crystals (EtOH) mp: 238.0-239.5°C | C ₁₈ H ₁₅ ClN ₂ O ₃ S Calc.: C, 49.49; H, 3.92; N, 12.82 Found: C, 49.44; H, 3.79; N, 12.90 |
| Ref. Ex.38 | p-SO ₂ NH ₂ | Cl | yellow crystals (EtOH) mp: 236.0-237.0°C | C ₁₇ H ₁₂ Cl ₂ N ₂ O ₂ S Calc.: C, 46.27; H, 3.20; N, 12.70 Found: C, 46.29; H, 3.07; N, 12.54 |

Table 5



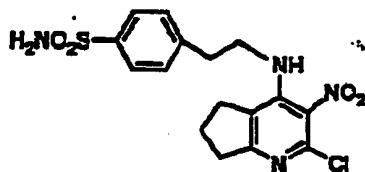
| | Properties (recrystallization solvent) | Elemental analysis |
|---------------|--|---|
| Ref. Ex.39 | yellow crystals (EtOH) mp: 196.5-197.5°C | C ₁₇ H ₁₃ ClN ₂ O ₂ S Calc.: C, 43.64; H, 3.17; N, 13.57 Found: C, 43.75; H, 3.06; N, 13.33 |

Table 6



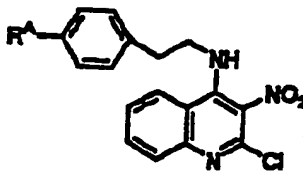
| | n | Properties (recrystallization solvent) | Elemental analysis |
|---------------|---|---|---|
| Ref. Ex.40 | 1 | yellow needle-like crystals (EtOH) mp: 212.0-213.0°C, decomposition | $C_{11}H_{11}ClN_2O_2S$ Calc.: C, 48.92; H, 3.34; N, 14.26 Found: C, 49.18; H, 3.26; N, 14.33 |
| Ref. Ex.41 | 3 | yellow plate crystals (CH ₃ CN) mp: 215.0-216.0°C | $C_{15}H_{15}ClN_2O_2S$ Calc.: C, 51.37; H, 4.07; N, 13.31 Found: C, 51.25; H, 4.09; N, 13.02 |

Table 7



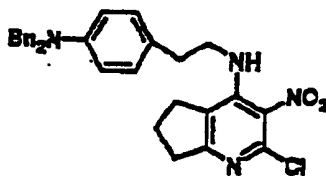
| | Properties (recrystallization solvent) | Elemental analysis |
|---------------|--|---|
| Ref. Ex.42 | yellow crystals (MeOH) mp: 216.0-217.0°C | $C_{14}H_{11}ClN_2O_2S$ Calc.: C, 48.32; H, 4.32; N, 14.12 Found: C, 48.29; H, 4.20; N, 14.10 |

Table 8



| | R ^a | Properties |
|----------------|------------------|---|
| Ref. Ex. 43 | NHTs | <p>yellowish brown liquid</p> <p>NMR spectrum δ (DMSO-d₆) ppm: 2.32(3H, s), 2.84(2H, t, J=8Hz), 3.28(2H, q, J=8Hz), 6.99(2H, d, J=8.5Hz), 7.07(2H, d, J=8.5Hz), 7.27(2H, d, J=8Hz), 7.58(2H, d, J=8Hz), 7.60-7.65(1H, m), 7.80-7.85(3H, m), 8.36(1H, d, J=8.5Hz), 9.98(1H, s)</p> <p>IR spectrum V(liq) cm⁻¹: 3416, 1528, 1160</p> |
| Ref. Ex. 44 | NBr ₂ | <p>reddish brown liquid</p> <p>NMR spectrum δ (CDCl₃) ppm: 2.89(2H, t, J=6.5Hz), 3.61(2H, q, J=6.5Hz), 4.66(4H, s), 5.84(1H, t, J=6.5Hz), 6.73(2H, d, J=8Hz), 7.04(2H, d, J=8Hz), 7.20-7.35(10H, m), 7.40(1H, t, J=8Hz), 7.61(1H, d, J=8Hz), 7.71(1H, t, J=8Hz), 7.89(1H, d, J=8Hz)</p> <p>Mass spectrum m/z: 522, 524(3:1, M⁺)</p> <p>IR spectrum V(liq) cm⁻¹: 3416, 1522</p> |
| Ref. Ex. 45 | CHMeOH | <p>yellow crystals</p> <p>NMR spectrum δ (CDCl₃) ppm: 1.50(3H, d, J=6Hz), 3.00(2H, t, J=7Hz), 3.73(2H, q, J=7Hz), 4.92(1H, q, J=6Hz), 5.86(1H, s), 7.23(2H, d, J=8Hz), 7.38(2H, d, J=8Hz), 7.45-7.50(1H, m), 7.65-7.75(2H, m), 7.89(1H, d, J=8.5Hz)</p> <p>IR spectrum V(KBr) cm⁻¹: 3424, 1516, 1364</p> <p>Mass spectrum m/z: 370, 372(3:1, M⁺)</p> |

Table 9



| | Properties |
|---------------|---|
| Ref. Ex.46 | orange liquid NMR spectrum δ (CDCl ₃) ppm: 2.09(2H, quintet, J=7.5Hz), 2.73(2H, t, J=7Hz), 2.89(2H, t, J=7.5Hz), 2.95(2H, t, J=7.5Hz), 3.58(2H, q, J=7Hz), 4.64(4H, s), 5.52(1H, br-s), 6.69(2H, d, J=8.5Hz), 6.94(2H, d, J=8.5Hz), 7.20-7.30(6H, m), 7.33(4H, m) IR spectrum V(liq) cm ⁻¹ : 3392, 1522 Mass spectrum m/z: 512, 514(3:1, M') |

Reference Example 47

N-[4-[2-[(2-chloro-3-nitroquinolin-4-yl)amino]ethyl]phenyl]-N-methylacetamide

To 2.59 g of 2-chloro-N-[2-[4-(methylamino)phenyl]ethyl]-3-nitroquinoline-4-amine there were added 26 ml of pyridine and 6.9 ml of acetic anhydride, and the mixture was stirred at room temperature for 1.5 hours. The solvent was distilled off under reduced pressure and the residue was washed with isopropyl ether to obtain 2.72 g of yellow crystals. Recrystallization from ethanol yielded yellow prism crystals with a melting point of 176.5-177.0°C.

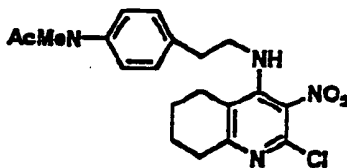
Elemental analysis: C₂₀H₁₉ClN₃O₂

Calculated: C, 60.23; H, 4.80; N, 14.05

Found: C, 60.28; H, 4.70; N, 14.01

The compound for Reference Example 48 listed in Table 10 was obtained by the same method as Reference Example 47.

Table 10



| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|--|
| Ref. Ex. 48 | yellow prism crystals (THF) mp: 171.0-172.5°C | C ₂₁ H ₂₁ ClN ₃ O Calc.: C, 59.63; H, 5.75; N, 13.91 Found: C, 59.50; H, 5.63; N, 13.95 |

Reference Example 49

2-chloro-5,6,7,8-tetrahydro-N-[2-[4-(N-methylbenzylamino)phenyl]ethyl]-3-nitroquinoline-4-amine

To a suspension of 36.8 g of 2-chloro-5,6,7,8-tetrahydro-N-[2-[4-(methylamino)phenyl]ethyl]-3-nitroquinoline-4-amine, 14.1 g of potassium carbonate and 370 ml of N,N-dimethylformamide there was added dropwise 12.4 ml of benzyl bromide at room temperature while stirring. After stirring at room temperature for 14 hours, the reaction mixture was added to ice water and extracted with methylene chloride. The extract was washed with water and then dewatered and concentrated under reduced pressure. The residue was purified by column chromatography [silica gel, methylene chloride/n-hexane (1:1)] to obtain 41.9 g of a red liquid.

IR spectrum $\nu(\text{liq})$ cm^{-1} : 3432, 1580, 1522

Mass spectrum m/z : 450, 452 (M^+ , 3:1), 210 (BP)

NMR spectrum δ (CDCl_3) ppm: 1.65-1.80 (4H, m), 2.02-2.15 (2H, m), 2.70-2.85 (4H, m), 3.03 (3H, s), 3.30 (2H, q, $J=6\text{Hz}$), 4.33 (1H, br-s), 4.53 (2H, s), 6.71 (2H, d, $J=8.5\text{Hz}$), 7.01 (2H, d, $J=8.5\text{Hz}$), 7.15-7.38 (5H, m), 7.22 (2H, d, $J=7.5\text{Hz}$), 7.24 (1H, t, $J=7.5\text{Hz}$), 7.31 (2H, t, $J=7.5\text{Hz}$)

Reference Example 50

N-[4-[2-[(2-dibenzylamino-3-nitroquinolin-4-yl)amino]ethyl]phenyl]acetamide

A mixture of 5.75 g of N-[4-[2-[(3-amino-2-chloroquinolin-4-yl)amino]ethyl]phenyl]acetamide and 11.9 ml of dibenzylamine was stirred at 100°C for 10 hours. Water and 10% hydrochloric acid were added to the reaction mixture, the precipitate was filtered off, and the mother liquor was extracted with methylene chloride. The extract was washed with water and then dewatered, and the solvent was distilled off. The resulting reddish orange oily residue was purified by column chromatography [silica gel,

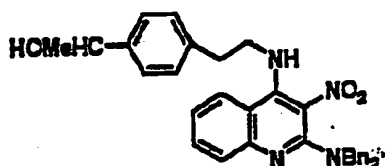
ethyl acetate/n-hexane (1:2-2:1)] to obtain 6.37 g of a reddish orange liquid.

IR spectrum $\nu(\text{liq}) \text{ cm}^{-1}$: 3320, 1668, 1522

NMR spectrum $\delta (\text{CDCl}_3) \text{ ppm}$: 2.15(3H, s), 2.88(2H, t, $J=7\text{Hz}$), 4.03(2H, q, $J=7\text{Hz}$), 4.50(4H, s), 7.00-7.30(13H, m), 7.42(2H, d, $J=8\text{Hz}$), 7.50-7.60(3H, m), 7.92(1H, d, $J=8\text{Hz}$)

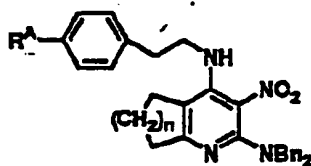
The compounds for Reference Examples 51-54 listed in Tables 11 and 12 were obtained by the same method as Reference Example 50.

Table 11



| Properties | |
|-------------|--|
| Ref. Ex. 51 | reddish orange liquid NMR spectrum $\delta (\text{CDCl}_3) \text{ ppm}$: 1.48(3H, d, $J=6.5\text{Hz}$), 1.78(1H, br-s), 2.91(2H, t, $J=7\text{Hz}$), 3.96(2H, q, $J=7\text{Hz}$), 4.50(4H, s), 4.86(1H, q, $J=6.5\text{Hz}$), 7.10-7.35(14H, m), 7.50-7.60(3H, m), 7.92(1H, d, $J=8\text{Hz}$) IR spectrum $\nu(\text{liq}) \text{ cm}^{-1}$: 3352, 1526 Mass spectrum m/z : 532 (M^+) |

Table 12



| Properties | | | |
|-------------|---------------------------------|---|---|
| Ref. | R ^a | n | |
| Ex. 52 | NHAc | 2 | orange liquid NMR spectrum $\delta (\text{CDCl}_3) \text{ ppm}$: 1.65-1.85(4H, m), 2.16(3H, s), 2.30-2.50(2H, m), 2.60-2.75(2H, m), 2.77(2H, t, $J=7\text{Hz}$), 3.45(2H, td, $J=7, 6\text{Hz}$), 4.34(4H, s), 5.78(1H, t, $J=6\text{Hz}$), 7.11(2H, d, $J=8.5\text{Hz}$), 7.15-7.30(10H, m), 7.41(2H, d, $J=8.5\text{Hz}$) IR spectrum $\nu(\text{liq}) \text{ cm}^{-1}$: 3316, 1670, 1518 |
| Ref. Ex. 53 | SO ₂ NH ₂ | 1 | reddish orange liquid NMR spectrum $\delta (\text{DMSO}-d_6) \text{ ppm}$: 1.95-2.05(2H, m), 2.68(2H, t, $J=8\text{Hz}$), 2.88(2H, t, $J=7\text{Hz}$), 3.00(2H, t, $J=7\text{Hz}$), 3.65(2H, td, $J=7, 6\text{Hz}$), 4.34(4H, s), 6.98(1H, t, $J=6\text{Hz}$), 7.10-7.30(12H, m), 7.38(2H, d, $J=8\text{Hz}$), 7.74(2H, d, $J=8\text{Hz}$) IR spectrum $\nu(\text{liq}) \text{ cm}^{-1}$: 3352, 1560, 1336 |
| Ref. Ex. 54 | NBn ₂ | 1 | reddish orange liquid |

| | | | |
|--|--|--|--|
| | | | <p>NMR spectrum δ (CDCl₃) ppm: 2.04(2H, quintet, J=7.5Hz), 2.75(2H, t, J=7Hz), 2.76(2H, t, J=7.5Hz), 3.08(2H, t, J=7.5Hz), 3.69(2H, q, J=7Hz), 4.40(4H, s), 4.63(4H, s), 6.68(2H, d, J=8.5Hz), 6.99(2H, d, J=8.5Hz), 7.12(4H, d, J=8Hz), 7.20-7.30(12H, m), 7.32(4H, t, J=8Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3344, 1522</p> <p>Mass spectrum m/z: 673(M⁺)</p> |
|--|--|--|--|

Reference Example 55

4-[2-[(2-N-methylbenzylamino-3-nitroquinolin-4-yl)amino]ethyl] benzenesulfonamide

After dissolving 2.41 g of 4-[2-[(2-chloro-3-nitroquinolin-4-yl)amino]ethyl] benzenesulfonamide in 7.6 ml of N-methylbenzylamine, the solution was stirred at 100°C for one hour. After cooling the reaction mixture to room temperature, 5% hydrochloric acid was added and extraction was performed with methylene chloride. After washing the extract first with water and then with saturated saline and dewatering, the solvent was distilled off under reduced pressure. The residue was purified by column chromatography [silica gel, methylene chloride/ethanol (50:1-40:1)] to obtain 2.34 g of reddish orange crystals. Recrystallization from methanol yielded reddish orange crystals with a melting point of 156.0-157.5°C.

Elemental analysis: C₂₂H₂₁N₃O₂S

Calculated: C, 65.05; H, 5.90; N, 15.17

Found: C, 64.81; H, 5.91; N, 14.90

Reference Example 56

4-[2-[(3-amino-2-chloroquinolin-4-yl)amino]ethyl] benzamide

After dissolving 2.05 g of nickel chloride·6H₂O in 32 ml of methanol and adding 1.18 g of sodium borohydride at room temperature, an N,N-dimethylformamide solution containing 6.41 g of 4-[2-[(2-chloro-3-nitroquinolin-4-yl)amino]ethyl] benzamide was added. Next, 0.65 g of sodium borohydride was gradually added. After filtering off the insoluble portion, the solvent was distilled off under reduced pressure and a mixed solution of water, ethyl acetate and methanol was added to the obtained residue prior to extraction. After washing the organic layer with saturated saline and dewatering, the solvent was distilled

off under reduced pressure. The residue was purified by column chromatography [silica gel, methylene chloride/methanol (30:1-10:1)] to obtain 2.88 g of light brown crystals.

Recrystallization from ethanol yielded light yellow crystals with a melting point of 220.0-220.5°C.

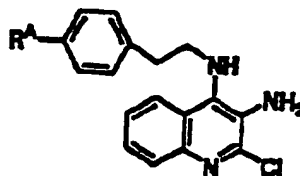
Elemental analysis: $C_{11}H_{11}ClN_2O$

Calculated: C, 63.44; H, 5.03; N, 16.44

Found: C, 63.28; H, 4.93; N, 16.24

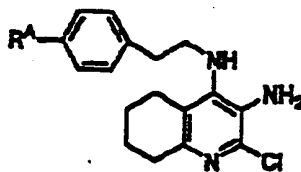
The compounds for Reference Examples 57-94 listed in Tables 13 to 25 were obtained by the same method as Reference Example 56.

Table 13



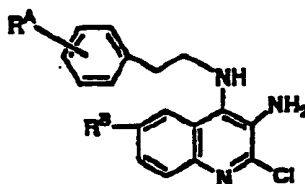
| | R ¹ | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---------------------------------|---|---|
| Ref. Ex. 57 | CONHMe | light green crystals (EtOH) mp: 148.0-150.0°C | C ₁₇ H ₁₄ ClN ₂ O Calc.: C, 64.31; H, 5.40; N, 15.79 Found: C, 64.39; H, 5.41; N, 15.97 |
| Ref. Ex. 58 | OH | faint brown crystals (AcOEt) mp: 218.0-220.0°C | C ₁₇ H ₁₄ ClN ₂ O Calc.: C, 65.07; H, 5.14; N, 13.39 Found: C, 65.04; H, 4.93; N, 13.29 |
| Ref. Ex. 59 | CO ₂ Et | faint brown needle- like crystals (iso-Pr ₂ O) mp: 113.0-115.0°C | C ₁₉ H ₁₆ ClN ₂ O Calc.: C, 64.95; H, 5.45; N, 11.36 Found: C, 65.09; H, 5.41; N, 11.40 |
| Ref. Ex. 60 | | light green crystals (EtOH) mp: 113.0-115.0°C | C ₁₇ H ₁₄ ClN ₂ O Calc.: C, 65.71; H, 5.78; N, 10.95 Found: C, 65.61; H, 5.82; N, 10.95 |
| Ref. Ex. 61 | SO ₂ NH ₂ | brown needle-like crystals (MeOH) mp: 202.5-204.0°C | C ₁₇ H ₁₄ ClN ₂ O ₂ S Calc.: C, 54.18; H, 4.55; N, 14.87 Found: C, 54.11; H, 4.47; N, 15.07 |
| Ref. Ex. 62 | NHMs | light brown crystals (AcOEt-n-Hexane) mp: 125.5-126.5°C | C ₁₇ H ₁₄ ClN ₂ O ₂ S Calc.: C, 55.31; H, 4.90; N, 14.33 Found: C, 55.14; H, 4.81; N, 14.09 |
| Ref. Ex. 63 | NHTs | colorless crystals (iso-PrOH) mp: 142.0-142.5°C | C ₁₇ H ₁₄ ClN ₂ O ₂ S Calc.: C, 61.73; H, 4.96; N, 12.00 Found: C, 61.61; H, 4.84; N, 11.82 |
| Ref. Ex. 64 | NHAc | light yellow prism crystals (CH ₂ Cl ₂) mp: 161.5-163.5°C | C ₁₇ H ₁₄ ClN ₂ O Calc.: C, 64.31; H, 5.40; N, 15.79 Found: C, 64.12; H, 5.24; N, 15.65 |

Table 14



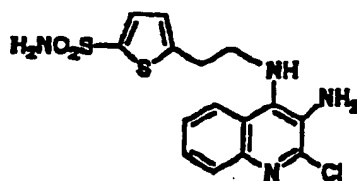
| | R ¹ | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---------------------------------|--|---|
| Ref. Ex. 65 | SO ₂ NH ₂ | light brown crystals (DMF-H ₂ O) mp: 201.5-202.5°C | C ₁₇ H ₁₄ ClN ₂ O ₂ S Calc.: C, 53.61; H, 5.56; N, 14.71 Found: C, 53.67; H, 5.46; N, 14.72 |
| Ref. Ex. 66 | NHAc | colorless crystals (Benzene) mp: 134.0-134.5°C | C ₁₇ H ₁₄ ClN ₂ O Calc.: C, 63.59; H, 6.46; N, 15.61 Found: C, 63.87; H, 6.50; N, 15.50 |
| Ref. Ex. 67 | NMeAc | brown needle-like crystals (AcOEt) mp: 156.0-158.0°C | C ₁₈ H ₁₆ ClN ₂ O Calc.: C, 64.42; H, 6.76; N, 15.03 Found: C, 64.38; H, 6.75; N, 14.93 |
| Ref. Ex. 68 | CHMeNHAc | colorless crystals (CH ₂ Cl ₂ -n-Hexane) mp: 132.0-134.0°C | C ₁₉ H ₁₈ ClN ₂ O Calc.: C, 65.19; H, 7.03; N, 14.48 Found: C, 65.08; H, 7.15; N, 14.40 |

Table 15



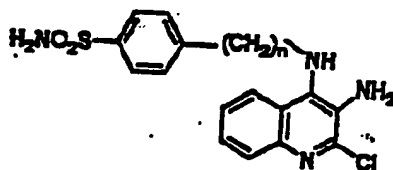
| | R ¹ | R ² | Properties (recrystallization, solvent) | Elemental analysis |
|----------------|-----------------------------------|----------------|---|---|
| Ref. Ex. 69 | m-SO ₂ NH ₂ | H | greenish brown crystals (CH ₃ CN) mp: 158.0-160.0°C | C ₁₇ H ₁₄ ClN ₂ O ₂ S·1/8H ₂ O Calc.: C, 53.86; H, 4.59; N, 14.78 Found: C, 53.78; H, 4.34; N, 14.67 |
| Ref. Ex. 70 | p-SO ₂ NH ₂ | Me | light brown crystals (EtOH) mp: 201.0-202.0°C | C ₁₈ H ₁₆ ClN ₂ O ₂ S Calc.: C, 55.31; H, 4.90; N, 14.33 Found: C, 55.32; H, 4.96; N, 14.11 |
| Ref. Ex. 71 | p-SO ₂ NH ₂ | OMe | light brown crystals (EtOH) mp: 196.5-198.0°C | C ₁₉ H ₁₈ ClN ₂ O ₂ S Calc.: C, 53.13; H, 4.71; N, 13.77 Found: C, 53.15; H, 4.71; N, 13.87 |

Table 16



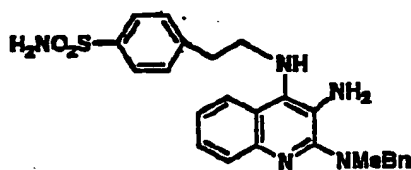
| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|--|---|
| Ref. Ex. 72 | light brown crystals (AcOEt) mp: 176.0-177.0°C | $C_{17}H_{11}ClN_2O_2S$ Calc.: C, 47.05; H, 3.95; N, 14.63 Found: C, 47.03; H, 3.89; N, 14.41 |

Table 17



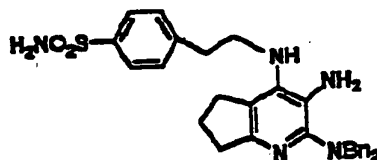
| | n | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|--|---|
| Ref. Ex. 73 | 1 | light yellowish brown needle-like crystals (EtOH) mp: 202.0-203.0°C | $C_{18}H_{11}ClN_2O_2S$ Calc.: C, 52.96; H, 4.17; N, 15.44 Found: C, 52.88; H, 4.29; N, 15.19 |
| Ref. Ex. 74 | 3 | light green needle- like crystals (MeOH) mp: 163.0-166.0°C | $C_{20}H_{13}ClN_2O_2S$ Calc.: C, 55.31; H, 4.90; N, 14.33 Found: C, 55.21; H, 4.99; N, 14.09 |

Table 18



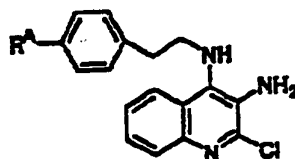
| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|---|
| Ref. Ex. 75 | light yellow crystals (AcOEt) mp: 182.0-183.0°C | $C_{27}H_{21}N_2O_2S$ Calc.: C, 65.05; H, 5.90; N, 15.17 Found: C, 64.81; H, 5.91; N, 14.90 |

Table 19



| | Properties (recrystallization solvent) | Elemental analysis |
|---------------|--|---|
| Ref. Ex.76 | gray crystals (DMF-H ₂ O) mp: 208.0-210.0°C | C ₂₁ H ₁₇ N ₃ O ₂ S Calc.: C, 68.28; H, 6.30; N, 13.27 Found: C, 68.30; H, 6.30; N, 13.25 |

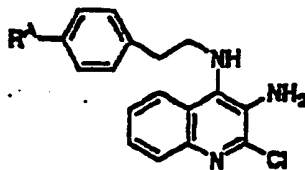
Table 20



| | R' | Properties |
|---------------|----------------------------------|--|
| Ref. Ex.77 | SO ₂ NHMe | green liquid NMR spectrum δ (DMSO-d ₆) ppm: 2.38(3H, d, J=5.5Hz), 2.93(2H, t, J=7.5Hz), 3.50(2H, td, J=7.5, 7Hz), 4.93(2H, br-s), 5.27(1H, t, J=7Hz), 7.24(1H, q, J=5.5Hz), 7.35-7.45(4H, m), 7.65(2H, d, J=8.5Hz), 7.66(1H, dd, J=8.5, 1Hz), 7.90(1H, dd, J=8.5, 1Hz), 7.95(1H, br-s) IR spectrum V(liq) cm ⁻¹ : 3360, 1360, 1184 Mass spectrum m/z: 390, 392(3:1, M') |
| Ref. Ex.78 | SO ₂ NHt | green liquid NMR spectrum δ (DMSO-d ₆) ppm: 0.95(3H, t, J=7.5Hz), 2.70-2.80(2H, m), 2.95(2H, t, J=7.5Hz), 3.50(2H, q, J=7.5Hz), 4.90(2H, br-s), 5.25(1H, t, J=7.5Hz), 7.30-7.45(5H, m), 7.60-7.80(3H, m), 7.80-7.90(1H, m) IR spectrum V(liq) cm ⁻¹ : 3352, 1386, 1184 Mass spectrum m/z: 404, 406(3:1, M') |
| Ref. Ex.79 | SO ₂ NH-n-Pr | green liquid NMR spectrum δ (DMSO-d ₆) ppm: 0.80(3H, t, J=7Hz), 1.35(2H, sextet, J=7Hz), 2.65(2H, q, J=7Hz), 2.90(2H, t, J=7.5Hz), 3.50(2H, q, J=7.5Hz), 4.95(2H, br-s), 5.25(1H, t, J=7.5Hz), 7.35-7.45(5H, m), 7.65-7.70(3H, m), 7.85-7.95(1H, m) IR spectrum V(liq) cm ⁻¹ : 3352, 1380, 1160 |
| Ref. Ex.80 | SO ₂ NMe ₂ | deep green liquid NMR spectrum δ (DMSO-d ₆) ppm: 2.57(6H, s), 2.96(2H, t, J=7Hz), 3.53(2H, q, J=7Hz), 4.93(2H, br-s), 5.29(1H, t, J=7Hz), 7.35-7.45(2H, m), 7.44(2H, d, J=8.5Hz), 7.59(2H, d, J=8.5Hz), 7.66(1H, dd, J=8, 1Hz), 7.90(1H, dd, J=8, 1Hz) IR spectrum V(liq) cm ⁻¹ : 3360, 1338, 1186 Mass spectrum m/z: 404, 406(3:1, M') |
| | | dark green liquid NMR spectrum δ (DMSO-d ₆) ppm: 2.83(2H, t, |

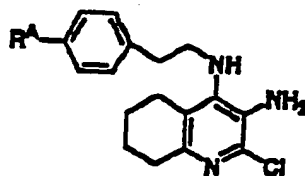
| | | |
|----------------|--------------------|--|
| Ref. Ex. 81 | CH ₃ OH | <p>J=7.5Hz), 3.45(2H, q, J=7.5Hz), 4.45(2H, d, J=5.5Hz), 4.90(2H, s), 4.96(1H, t, J=5.5Hz), 5.24(1H, t, J=7.5Hz), 7.16(2H, d, J=8Hz), 7.21(2H, d, J=8Hz), 7.35-7.45(2H, m), 7.68(1H, dd, J=8.5, 2Hz), 7.97(1H, dd, J=8.5, 2Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3352</p> <p>Mass spectrum m/z: 327, 329(3:1, M')</p> |
|----------------|--------------------|--|

Table 21



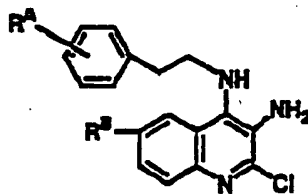
| | R' | Properties |
|---------------|------------------|--|
| Ref. Ex.82 | NBn ₂ | <p>brown liquid</p> <p>NMR spectrum δ (CDCl₃) ppm: 2.82(2H, t, J=6.5Hz), 3.44(2H, q, J=6.5Hz), 3.76(1H, t, J=6.5Hz), 3.85(2H, br-s), 4.67(4H, m), 6.73(2H, d, J=8.5Hz), 7.06(2H, d, J=8.5Hz), 7.20-7.40(1H, m), 7.40-7.50(2H, m), 7.86(1H, d, J=8Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3440, 3356</p> <p>Mass spectrum m/z: 492, 494(3:1, M')</p> |
| Ref. Ex.83 | CHMeNHAc | <p>brown liquid</p> <p>NMR spectrum δ (DMSO-d₆) ppm: 1.30(3H, d, J=7.5Hz), 1.82(3H, s), 2.81(2H, t, J=7.5Hz), 3.44(2H, td, J=7.5, 7Hz), 4.85(1H, q, J=7.5Hz), 4.90(2H, s), 5.24(1H, t, J=7Hz), 7.13(2H, d, J=8Hz), 7.18(2H, d, J=8Hz), 7.35-7.50(2H, m), 7.67(1H, dd, J=8, 1Hz), 7.90-8.00(1H, m), 8.07(1H, d, J=7.5Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3336, 1656</p> <p>Mass spectrum m/z: 382(M')</p> |
| Ref. Ex.84 | NMeAc | <p>colorless liquid</p> <p>NMR spectrum δ (DMSO-d₆) ppm: 1.74(3H, s), 2.87(2H, t, J=7Hz), 3.11(3H, s), 3.50(2H, q, J=7Hz), 4.90(2H, br-s), 5.26(1H, t, J=7Hz), 7.15(2H, d, J=8.5Hz), 7.24(2H, d, J=8.5Hz), 7.30-7.45(2H, m), 7.67(1H, dd, J=8.5, 1Hz), 7.92(1H, dd, J=8.5, 1Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3344, 1646</p> <p>Mass spectrum m/z: 368(M')</p> |

Table 22



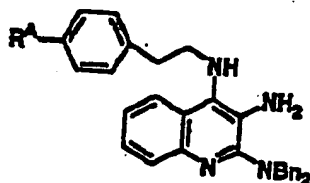
| | R ^a | Properties |
|---------------|--------------------|---|
| Ref. Ex.85 | CH ₂ OH | brown liquid NMR spectrum δ (DMSO-d ₆) ppm: 1.60-1.75(4H, m), 2.44(2H, t, J=6Hz), 2.58(2H, t, J=6Hz), 2.72(2H, t, J=7.5Hz), 3.28(2H, td, J=7.5, 6Hz), 4.36(2H, br-s), 4.41(1H, t, J=6Hz), 4.45(2H, d, J=6Hz), 4.96(1H, t, J=6Hz), 7.13(2H, d, J=8.5Hz), 7.21(2H, d, J=8.5Hz) IR spectrum V(liq) cm ⁻¹ : 3352 Mass spectrum m/z: 331, 333(3:1, M ⁺) |
| Ref. Ex.86 | NHMs | light brown liquid NMR spectrum δ (DMSO-d ₆) ppm: 1.60-1.75(4H, m), 2.41(2H, t, J=6Hz), 2.57(2H, t, J=6Hz), 2.70(2H, t, J=7Hz), 2.92(3H, s), 3.28(2H, q, J=7Hz), 4.36(2H, br-s), 4.40(1H, t, J=7Hz), 7.11(2H, d, J=8.5Hz), 7.14(2H, d, J=8.5Hz), 9.46(1H, br-s) IR spectrum V(liq) cm ⁻¹ : 3356, 3264, 1336, 1154 Mass spectrum m/z: 394, 396(3:1, M ⁺) |
| Ref. Ex.87 | NMeBn | brown liquid NMR spectrum δ (CDCl ₃) ppm: 1.60-1.80(4H, m), 2.20-2.35(2H, m), 2.65-2.80(4H, m), 3.02(3H, s), 3.20-3.40(3H, m), 3.52(2H, br-s), 4.52(2H, s), 6.70(2H, d, J=8.5Hz), 7.05(2H, d, J=8.5Hz), 7.15-7.40(5H, m), 7.21(2H, d, J=7.5Hz), 7.20-7.30(1H, m), 7.31(2H, t, J=7.5Hz) IR spectrum V(liq) cm ⁻¹ : 3356 Mass spectrum m/z: 420, 422(3:1, M ⁺) |

Table 23



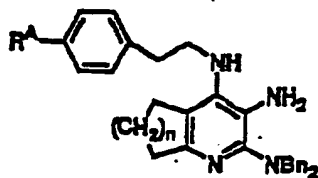
| | R ^A | R ^B | Properties |
|----------------|-----------------------------------|----------------|--|
| Ref. Ex. 88 | o-SO ₂ NH ₂ | H | <p>light green liquid</p> <p>NMR spectrum δ (DMSO-d₆) ppm: 3.32(2H, t, J=8Hz), 3.52(2H, td, J=8, 7Hz), 4.94(2H, br-s), 5.22(1H, t, J=7Hz), 7.35-7.45(7H, m), 7.49(1H, td, J=6, 1Hz), 7.67(1H, dd, J=8, 1Hz), 7.88(1H, dd, J=8, 1Hz), 7.95-8.00(1H, m)</p> <p>IR spectrum V(liq) cm⁻¹: 3428, 3330, 1180</p> <p>Mass spectrum m/z: 376, 378(3:1, M⁺)</p> |
| Ref. Ex. 89 | p-SO ₂ NH ₂ | Cl | <p>reddish brown crystals</p> <p>NMR spectrum δ (DMSO-d₆) ppm: 2.91(2H, t, J=7.5Hz), 3.43(2H, td, J=7.5, 6.5Hz), 5.08(2H, br-s), 5.35(1H, t, J=6.5Hz), 7.16(2H, br-s), 7.39(1H, dd, J=9, 2.5Hz), 7.40(2H, d, J=8.5Hz), 7.69(1H, d, J=9Hz), 7.73(2H, d, J=8.5Hz), 8.01(1H, d, J=2.5Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3444, 3372, 1330, 1160</p> <p>Mass spectrum m/z: 410, 412, 414(9:6:1, M⁺)</p> |

Table 24



| | R ^a | Properties |
|---------------|----------------|--|
| Ref. Ex.90 | CHMeOH | <p>yellowish brown liquid</p> <p>NMR spectrum δ (CDCl₃) ppm: 1.50(3H, d, J=6Hz), 1.75(1H, br-s), 2.92(2H, t, J=7Hz), 3.46(2H, t, J=7Hz), 3.50(1H, br-s), 4.00(2H, br-s), 4.50(4H, s), 4.90(1H, q, J=6Hz), 7.15-7.40(17H, m), 7.77(1H, d, J=7.5Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3416</p> <p>Mass spectrum m/z: 502(M⁺)</p> |
| Ref. Ex.91 | NMeAc | <p>brown liquid</p> <p>NMR spectrum δ (CDCl₃) ppm: 1.86(3H, br-s), 2.94(2H, t, J=7Hz), 3.25(3H, br-s), 3.48(2H, td, J=7.5.5Hz), 3.60(1H, t, J=5.5Hz), 4.01(2H, br-s), 4.51(4H, s), 7.12(2H, d, J=8Hz), 7.18-7.42(15H, m), 7.79(1H, d, J=8.5Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3420, 3370, 1660</p> <p>Mass spectrum m/z: 529(M⁺)</p> |
| Ref. Ex.92 | NHAc | <p>brown liquid</p> <p>NMR spectrum δ (CDCl₃) ppm: 2.17(3H, s), 2.88(2H, t, J=6.5Hz), 3.44(2H, t, J=6.5Hz), 3.57(1H, br-s), 4.00(2H, br-s), 4.50(4H, s), 7.15(1H, br-s), 7.15-7.30(13H, m), 7.36(1H, t, J=7.5Hz), 7.40-7.45(3H, m), 7.78(1H, d, J=8.5Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3324, 1670</p> <p>Mass spectrum m/z: 515(M⁺)</p> |

Table 25



| | R ¹ | n | Properties |
|---------------|------------------|---|--|
| Ref. Ex.93 | NHAc | 2 | brown liquid NMR spectrum δ (CDCl ₃) ppm: 1.60-1.80(4H, m), 2.17(3H, s), 2.20-2.35(2H, m), 2.65-2.75(2H, m), 2.73(2H, t, J=6.5Hz), 3.34(2H, t, J=6.5Hz), 3.61(2H, br-s), 4.23(4H, s), 7.11(2H, d, J=8Hz), 7.15-7.33(10H, m), 7.41(2H, d, J=8Hz) IR spectrum V(liq) cm ⁻¹ : 3412, 3320, 1668 Mass spectrum m/z: 519(M ⁺) |
| Ref. Ex.94 | NBn ₂ | 1 | green liquid NMR spectrum δ (CDCl ₃) ppm: 2.02(2H, quintet, J=6.5Hz), 2.62(2H, t, J=6.5Hz), 2.83(2H, t, J=6.5Hz), 2.87(2H, t, J=6.5Hz), 3.17(2H, br-s), 3.49(2H, t, J=6.5Hz), 3.65(1H, br-s), 4.12(4H, s), 4.63(4H, s), 6.63(2H, d, J=8.5Hz), 6.85(2H, d, J=8.5Hz), 7.15(2H, t, J=7.5Hz), 7.20-7.30(14H, m), 7.32(4H, t, J=7.5Hz) IR spectrum V(liq) cm ⁻¹ : 3384 Mass spectrum m/z: 643(M ⁺) |

Reference Example 95

4-[2-(4-chloro-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzamide

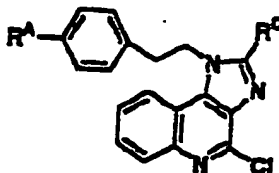
Upon adding 10 ml of ethyl orthoformate to 2.45 g of 4-[2-[(3-amino-2-chloroquinolin-4-yl)amino]ethyl]benzamide, the mixture was stirred at 80-120°C for 5 hours. After addition of n-hexane at room temperature, the precipitated crystals were filtered off and washed with isopropyl ether to obtain 2.29 g of light brown crystals. Recrystallization from acetonitrile yielded colorless crystals with a melting point of 287.0-288.0°C. Elemental analysis: C₁₆H₁₁ClN₃O

Calculated: C, 65.05; H, 4.31; N, 15.97

Found: C, 64.80; H, 4.08; N, 16.15

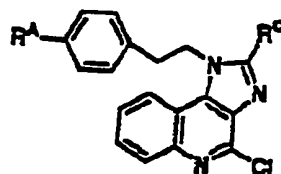
The compounds for Reference Examples 96-147 listed in Tables 26 to 34 were obtained by the same method as Reference Example 95.

Table 26



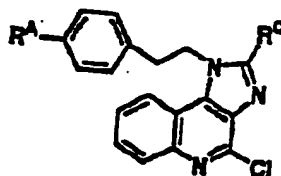
| | R ¹ | R ² | Properties (recrystallization solvent) | Elemental analysis |
|----------------|------------------------------------|----------------|--|---|
| Ref. Ex.96 | CONHMe | H | light brown crystals (EtOH) mp: 220.0-222.0°C | C ₁₇ H ₁₃ ClN ₂ O Calc.: C, 65.84; H, 4.70; N, 15.36 Found: C, 65.66; H, 4.76; N, 15.07 |
| Ref. Ex.97 | OH | H | light brown crystals (DMF-H ₂ O) mp: 231.0-232.0°C | C ₁₇ H ₁₃ ClN ₂ O Calc.: C, 66.77; H, 4.36; N, 12.98 Found: C, 67.04; H, 4.06; N, 13.07 |
| Ref. Ex.98 | CO ₂ Et | H | light brown crystals (iso-PrOH) mp: 128.0-129.0°C | C ₁₉ H ₁₇ ClN ₂ O Calc.: C, 66.40; H, 4.78; N, 11.06 Found: C, 66.50; H, 4.57; N, 11.05 |
| Ref. Ex.99 | | H | colorless crystals (EtOH) mp: 165.5-167.5°C | C ₁₇ H ₁₃ ClN ₂ O Calc.: C, 67.09; H, 5.12; N, 10.67 Found: C, 67.13; H, 5.08; N, 10.72 |
| Ref. Ex.100 | SO ₂ NH ₂ Et | H | light green crystals (EtOH) mp: 205.0-206.5°C | C ₁₇ H ₁₃ ClN ₂ O ₂ S Calc.: C, 57.90; H, 4.62; N, 13.50 Found: C, 58.18; H, 4.59; N, 13.53 |
| Ref. Ex.101 | SO ₂ NH-n-Pr | H | light yellow plate crystals (MeOH) mp: 231.5-234.5°C | C ₁₉ H ₁₇ ClN ₂ O ₂ S Calc.: C, 58.80; H, 4.93; N, 13.06 Found: C, 58.68; H, 4.71; N, 12.92 |
| Ref. Ex.102 | SO ₂ NMe ₂ | H | light yellow crystals (CH ₃ CN) mp: 233.5-235.0°C | C ₁₇ H ₁₃ ClN ₂ O ₂ S Calc.: C, 57.90; H, 4.62; N, 13.50 Found: C, 57.71; H, 4.53; N, 13.26 |
| Ref. Ex.103 | SO ₂ NH ₂ | H | light yellowish brown crystals (DMF-H ₂ O) mp: 265.0-266.5°C | C ₁₇ H ₁₃ ClN ₂ O ₂ S Calc.: C, 55.89; H, 3.91; N, 14.48 Found: C, 55.72; H, 3.73; N, 14.52 |
| Ref. Ex.104 | SO ₂ NHMe | H | yellow crystals (DMF-H ₂ O) mp: 216.5-217.5°C | C ₁₇ H ₁₃ ClN ₂ O ₂ S Calc.: C, 56.93; H, 4.27; N, 13.98 Found: C, 56.79; H, 4.43; N, 13.80 |

Table 27



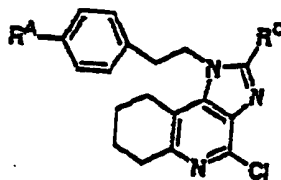
| | R ^a | R ^c | Properties (recrystallization solvent) | Elemental analysis |
|----------------|----------------------|----------------|--|---|
| Ref. Ex.105 | SO ₂ NHMe | Me | colorless crystals (DMF-H ₂ O) mp: 253.0-254.0°C | C ₁₇ H ₁₁ ClN ₃ O ₂ S Calc.: C, 57.90; H, 4.62; N, 13.50 Found: C, 57.92; H, 4.40; N, 13.48 |
| Ref. Ex.106 | SO ₂ NHMe | Et | light yellow crystals (DMF-H ₂ O) mp: 272.5-273.5°C | C ₁₉ H ₁₃ ClN ₃ O ₂ S Calc.: C, 58.80; H, 4.93; N, 13.06 Found: C, 58.61; H, 4.87; N, 12.95 |
| Ref. Ex.107 | SO ₂ NHMe | n-Pr | light yellow crystals (DMF-H ₂ O) mp: 260.5-261.5°C | C ₂₁ H ₁₅ ClN ₃ O ₂ S Calc.: C, 59.65; H, 5.23; N, 12.65 Found: C, 59.70; H, 5.21; N, 12.51 |
| Ref. Ex.108 | SO ₂ NHMe | n-Bu | light brown crystals (DMF-H ₂ O) mp: 205.5-206.0°C | C ₂₃ H ₁₇ ClN ₃ O ₂ S Calc.: C, 60.45; H, 5.51; N, 12.26 Found: C, 60.45; H, 5.47; N, 12.25 |
| Ref. Ex.109 | CH ₂ OH | H | light brown crystals (EtOH) mp: 191.0-193.0°C | C ₁₇ H ₁₁ ClN ₃ O Calc.: C, 67.56; H, 4.77; N, 12.44 Found: C, 67.58; H, 4.58; N, 12.27 |
| Ref. Ex.110 | CH ₂ OH | n-Bu | light yellow crystals (AcOEt) mp: 177.5-178.5°C | C ₂₁ H ₁₅ ClN ₃ O Calc.: C, 70.13; H, 6.14; N, 10.67 Found: C, 70.16; H, 6.03; N, 10.61 |
| Ref. Ex.111 | NHMs | H | colorless prism crystals (EtOH) mp: 218.5-220.0°C | C ₁₇ H ₁₁ ClN ₃ O ₂ S Calc.: C, 56.93; H, 4.27; N, 13.98 Found: C, 56.95; H, 4.26; N, 13.77 |
| Ref. Ex.112 | NHMs | Me | light brown crystals (EtOH) mp: 249.0-250.0°C | C ₁₉ H ₁₃ ClN ₃ O ₂ S Calc.: C, 57.90; H, 4.62; N, 13.50 Found: C, 57.96; H, 4.74; N, 13.21 |
| Ref. Ex.113 | NHMs | Et | light brown prism crystals (EtOH) mp: 240.0-240.5°C | C ₂₁ H ₁₅ ClN ₃ O ₂ S Calc.: C, 58.80; H, 4.93; N, 13.06 Found: C, 58.67; H, 4.84; N, 12.94 |
| Ref. Ex.114 | NHMs | n-Pr | colorless crystals (MeOH) mp: 221.5-224.0°C | C ₂₃ H ₁₇ ClN ₃ O ₂ S Calc.: C, 59.65; H, 5.23; N, 12.65 Found: C, 59.65; H, 5.15; N, 12.63 |
| Ref. Ex.115 | NHMs | n-Bu | light yellow crystals (MeOH) mp: 199.5-200.5°C | C ₂₅ H ₁₉ ClN ₃ O ₂ S Calc.: C, 60.45; H, 5.51; N, 12.26 Found: C, 60.45; H, 5.44; N, 12.20 |

Table 28



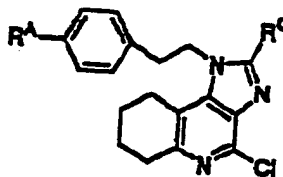
| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|----------------|------------------|----------------|--|---|
| Ref. Ex.116 | NHTs | H | light yellow needle- like crystals (DMF-H ₂ O) mp: 246.5-247.0°C | C ₁₇ H ₁₁ ClN ₃ O ₂ S Calc.: C, 62.95; H, 4.44; N, 11.75 Found: C, 62.79; H, 4.36; N, 12.03 |
| Ref. Ex.117 | NHAc | H | colorless crystals (EtOH) mp: 276.0-277.0°C | C ₁₇ H ₁₁ ClN ₃ O Calc.: C, 65.84; H, 4.70; N, 15.36 Found: C, 65.66; H, 4.76; N, 15.09 |
| Ref. Ex.118 | NHAc | Me | faint yellow needle- like crystals (MeOH) mp: 250.0-251.0°C | C ₁₈ H ₁₃ ClN ₃ O Calc.: C, 66.58; H, 5.05; N, 14.79 Found: C, 66.46; H, 5.03; N, 14.80 |
| Ref. Ex.119 | NHAc | Et | yellowish orange crystals (AcOEt) mp: 215.0-215.5°C | C ₁₉ H ₁₅ ClN ₃ O Calc.: C, 67.26; H, 5.39; N, 14.26 Found: C, 67.44; H, 5.41; N, 14.22 |
| Ref. Ex.120 | NHAc | n-Bu | light brown crystals (MeOH) mp: 220.0-220.5°C | C ₂₁ H ₁₉ ClN ₃ O Calc.: C, 68.48; H, 5.99; N, 13.31 Found: C, 68.47; H, 6.00; N, 13.58 |
| Ref. Ex.121 | NMeAc | H | colorless needle-like crystals (EtOH) mp: 137.0-137.5°C | C ₁₇ H ₁₁ ClN ₃ O Calc.: C, 66.58; H, 5.05; N, 14.79 Found: C, 66.50; H, 4.96; N, 14.77 |
| Ref. Ex.122 | NMeAc | Me | colorless crystals (iso-PrOH) mp: 248.5-249.0°C | C ₁₈ H ₁₃ ClN ₃ O Calc.: C, 67.26; H, 5.39; N, 14.26 Found: C, 67.30; H, 5.42; N, 14.24 |
| Ref. Ex.123 | NMeAc | Et | faint brown prism crystals (THF) mp: 233.0-234.5°C | C ₁₉ H ₁₅ ClN ₃ O Calc.: C, 67.89; H, 5.70; N, 13.77 Found: C, 68.06; H, 5.58; N, 13.94 |
| Ref. Ex.124 | NMeAc | n-Bu | colorless crystals (AcOEt-iso-Pr ₂ O) mp: 175.5-176.0°C | C ₂₁ H ₁₉ ClN ₃ O Calc.: C, 69.03; H, 6.26; N, 12.88 Found: C, 69.07; H, 6.22; N, 12.85 |
| Ref. Ex.125 | NBn ₁ | n-Bu | colorless crystals (AcOEt) mp: 151.5-152.5°C | C ₂₁ H ₁₉ ClN ₃ Calc.: C, 77.33; H, 6.31; N, 10.02 Found: C, 77.42; H, 6.29; N, 10.11 |
| Ref. Ex.126 | CHMeNHAc | Et | light yellow crystals (AcOEt) mp: 188.5-190.5°C | C ₁₉ H ₁₅ ClN ₃ O Calc.: C, 68.48; H, 5.99; N, 13.31 Found: C, 68.27; H, 6.11; N, 13.21 |

Table 29



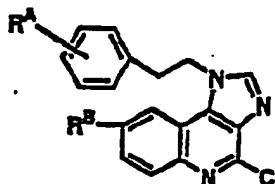
| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|-----------------|---------------------------------|----------------|--|---|
| Ref. Ex. 127 | SO ₂ NH ₂ | H | light yellowish brown crystals (DMF-H ₂ O) mp: 247.5-249.5°C | C ₂₁ H ₁₇ ClN ₃ O ₂ S Calc.: C, 55.31; H, 4.90; N, 14.33 Found: C, 55.03; H, 4.76; N, 14.40 |
| Ref. Ex. 128 | NHMs | H | colorless crystals (iso-PrOH) mp: 202.0-204.0°C | C ₂₁ H ₁₇ ClN ₃ O ₂ S Calc.: C, 56.36; H, 5.23; N, 13.84 Found: C, 56.51; H, 5.41; N, 13.57 |
| Ref. Ex. 129 | NHMs | Me | colorless prism crystals (EtOH) mp: 247.0-248.0°C | C ₂₂ H ₁₉ ClN ₃ O ₂ S Calc.: C, 57.34; H, 5.53; N, 13.37 Found: C, 57.34; H, 5.72; N, 13.16 |
| Ref. Ex. 130 | NHMs | n-Bu | colorless needle-like crystals (AcOEt) mp: 164.0-165.0°C | C ₂₅ H ₂₁ ClN ₃ O ₂ S Calc.: C, 59.92; H, 6.34; N, 12.15 Found: C, 59.70; H, 6.22; N, 11.95 |
| Ref. Ex. 131 | NHAc | H | colorless crystals (MeOH) mp: 247.0-249.0°C | C ₂₀ H ₁₅ ClN ₃ O Calc.: C, 64.95; H, 6.00; N, 15.15 Found: C, 65.14; H, 5.72; N, 15.23 |
| Ref. Ex. 132 | NHAc | Me | colorless needle-like crystals (EtOH) mp: 249.0-250.0°C | C ₂₁ H ₁₇ ClN ₃ O Calc.: C, 65.87; H, 6.05; N, 14.63 Found: C, 65.82; H, 6.05; N, 14.61 |
| Ref. Ex. 133 | NHAc | Et | colorless crystals (AcOEt) mp: 202.0-202.5°C | C ₂₂ H ₁₉ ClN ₃ O Calc.: C, 66.57; H, 6.35; N, 14.12 Found: C, 66.32; H, 6.24; N, 14.04 |
| Ref. Ex. 134 | NHAc | n-Bu | colorless crystals (AcOEt) mp: 192.0-193.0°C | C ₂₅ H ₂₁ ClN ₃ O Calc.: C, 67.83; H, 6.88; N, 13.18 Found: C, 67.89; H, 7.02; N, 12.93 |
| Ref. Ex. 135 | NMeAc | H | light brown crystals (iso-PrOH) mp: 191.5-192.5°C | C ₂₁ H ₁₇ ClN ₃ O Calc.: C, 65.87; H, 6.05; N, 14.63 Found: C, 66.07; H, 6.02; N, 14.61 |
| Ref. Ex. 136 | NMeAc | Me | colorless crystals (EtOH) mp: 229.0-230.0°C | C ₂₂ H ₁₉ ClN ₃ O Calc.: C, 66.57; H, 6.35; N, 14.12 Found: C, 66.40; H, 6.35; N, 14.11 |
| Ref. Ex. 137 | NMeAc | Et | colorless needle-like crystals (THF) mp: 217.5-218.5°C | C ₂₃ H ₂₁ ClN ₃ O Calc.: C, 67.22; H, 6.62; N, 13.63 Found: C, 67.17; H, 6.62; N, 13.68 |
| Ref. Ex. 138 | NMeAc | n-Bu | colorless crystals (AcOEt-iso-Pr ₂ O) mp: 147.0-148.0°C | C ₂₆ H ₂₃ ClN ₃ O Calc.: C, 68.40; H, 7.12; N, 12.76 Found: C, 68.52; H, 7.17; N, 12.77 |

Table 30



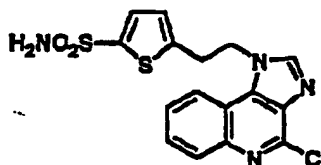
| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|----------------|----------------|----------------|--|--|
| Ref. Ex.139 | CHMeNHAc | H | colorless crystals (AcOEt) mp: 192.5-193.5°C | C ₁₇ H ₁₁ ClN ₃ O Calc.: C, 66.57; H, 6.35; N, 14.12 Found: C, 66.63; H, 6.47; N, 14.29 |

Table 31



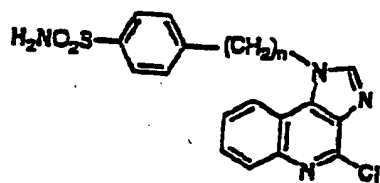
| | R ^A | R ^B | Properties (recrystallization solvent) | Elemental analysis |
|----------------|-----------------------------------|----------------|---|---|
| Ref. Ex.140 | m-SO ₂ NH ₂ | H | brown crystals (DMF-H ₂ O) mp: 261.0-262.5°C | C ₁₇ H ₁₁ ClN ₃ O ₂ S·1/4H ₂ O Calc.: C, 55.24; H, 3.99; N, 14.32 Found: C, 55.06; H, 3.71; N, 14.44 |
| Ref. Ex.141 | p-SO ₂ NH ₂ | Me | light brown crystals (CH ₃ CN) mp: 276.5-278.0°C | C ₁₈ H ₁₃ ClN ₃ O ₂ S Calc.: C, 56.93; H, 4.27; N, 13.98 Found: C, 56.66; H, 4.11; N, 13.81 |
| Ref. Ex.142 | p-SO ₂ NH ₂ | OMe | light brown crystals (CH ₃ CN) mp: 266.5-268.0°C | C ₁₉ H ₁₅ ClN ₃ O ₃ S Calc.: C, 54.74; H, 4.11; N, 13.44 Found: C, 54.47; H, 3.96; N, 13.29 |
| Ref. Ex.143 | p-SO ₂ NH ₂ | Cl | light brown crystals (CH ₃ CN) mp: 263.0-264.0°C | C ₁₇ H ₉ Cl ₂ N ₃ O ₂ S Calc.: C, 51.32; H, 3.35; N, 13.30 Found: C, 51.13; H, 3.16; N, 13.07 |

Table 32



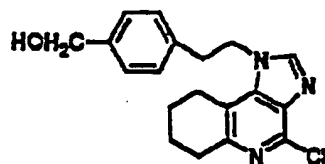
| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|---|
| Ref. Ex.144 | light brown crystals (CH ₃ CN) mp: 238.5-239.5°C | C ₁₇ H ₁₁ ClN ₃ O ₂ S Calc.: C, 48.91; H, 3.34; N, 14.26 Found: C, 49.08; H, 3.23; N, 14.53 |

Table 33



| | n | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|---|---|
| Ref. Ex.145 | 1 | colorless needle-like crystals (EtOH) mp: 260.0-261.0°C | $C_{17}H_{14}ClN_3O_2S$ Calc.: C, 54.77; H, 3.51; N, 15.03 Found: C, 54.73; H, 3.48; N, 14.84 |
| Ref. Ex.146 | 3 | colorless crystals (DMF-H ₂ O) mp: 183.5-184.0°C | $C_{17}H_{14}ClN_3O_2S$ Calc.: C, 56.93; H, 4.27; N, 13.98 Found: C, 56.65; H, 4.25; N, 13.68 |

Table 34



| | Properties |
|----------------|---|
| Ref. Ex.147 | colorless crystals NMR spectrum δ (DMSO-d ₆) ppm: 1.81(4H, br-s), 2.88(2H, br-s), 3.10(2H, br-s), 3.10(2H, t, J=7.5Hz), 4.50(2H, s), 4.61(2H, t, J=7.5Hz), 5.24(1H, s), 7.10(2H, d, J=8Hz), 7.22(2H, d, J=8Hz), 8.04(1H, s) IR spectrum V(liq) cm ⁻¹ : 3436 |

Reference Example 148

4-[2-(4-chloro-2-methyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]-N-(1-ethoxyethylidene)benzenesulfonamide

Upon adding 9.4 ml of ethyl orthoformate to 2.34 g of 4-[2-[(3-amino-2-chloroquinolin-4-yl)amino]ethyl] benzenesulfonamide, the mixture was stirred at 140°C overnight. After cooling the reaction solution, n-hexane was added for decantation, and then the residue was purified by column chromatography [silica gel, ethyl acetate/n-hexane (1:1-4:1)]. This was crystallized from a mixed solution of ethyl acetate and n-hexane to obtain 1.67 g of crystals. Recrystallization from ethyl acetate yielded yellow

needle-like crystals with a melting point of 151.0-152.0°C.

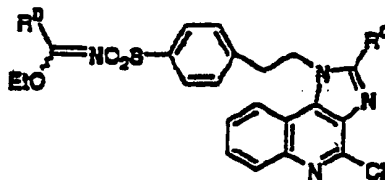
Elemental analysis: $C_{12}H_2ClN_4O_5S$

Calculated: C, 58.65; H, 4.92; N, 11.90

Found: C, 58.59; H, 4.70; N, 11.71

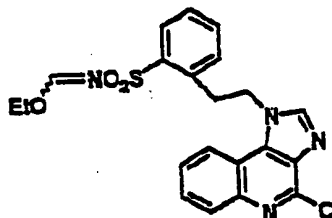
The compounds for Reference Examples 149-152 listed in Tables 35 and 36 were obtained by the same method as Reference Example 148.

Table 35



| | R ^c | R ^d | Properties (recrystallization solvent) | Elemental analysis |
|----------------|----------------|----------------|---|---|
| Ref. Ex.149 | Et | Et | light yellowish brown crystals (DMF) mp: 177.0-178.0°C | C ₂₇ H ₂₇ ClN ₃ O ₂ S Calc.: C, 60.17; H, 5.45; N, 11.23 Found: C, 60.02; H, 5.46; N, 11.11 |
| Ref. Ex.150 | n-Pr | n-Pr | yellow needle-like crystals (iso-PrOH) mp: 117.0-117.5°C | C ₃₀ H ₃₁ ClN ₃ O ₂ S Calc.: C, 61.53; H, 5.93; N, 10.63 Found: C, 61.41; H, 5.90; N, 10.84 |
| Ref. Ex.151 | n-Bu | n-Bu | yellowish brown crystals (AcOEt-n-Hex) mp: 99.0-100.5°C | C ₃₃ H ₃₅ ClN ₃ O ₂ S Calc.: C, 62.74; H, 6.35; N, 10.09 Found: C, 62.58; H, 6.41; N, 10.13 |

Table 36



| | Properties |
|----------------|---|
| Ref. Ex.152 | reddish brown crystals NMR spectrum δ (DMSO-d ₆) ppm: 1.00-1.25(3H, m), 3.71(2H, t, J=7Hz), 4.22(2H, q, J=7Hz), 5.09(2H, t, J=7Hz), 7.10-7.15(1H, m), 7.40-7.60(2H, m), 7.65-7.80(2H, m), 7.90-8.00(1H, m), 8.08(1H, dd, J=8, 1Hz), 8.25(1H, s), 8.50-8.55(1H, m), 8.65(1H, s) IR spectrum V(liq) cm ⁻¹ : 1366, 1162 Mass spectrum m/z: 442, 444(3:1, M) |

Reference Example 153

4-[2-(4-chloro-2-ethyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl propionate

After dissolving 3.00 g of 4-[2-[(3-amino-2-chloro-quinolin-4-yl)amino]ethyl]benzyl alcohol in 75 ml of toluene, 3.1 ml of propionyl chloride was added. After stirring at room temperature for 3 hours, 0.17 g of p-toluenesulfonic acid·1H₂O was added and reflux was carried out for 6 hours, after which the reaction mixture was concentrated under reduced pressure,

the residue was dissolved in methylene chloride, and the mixture was washed first with 10% ammonia water, water and then saturated saline. After dewatering the methylene chloride layer, the solvent was distilled off under reduced pressure. The residue was purified by column chromatography [silica gel, methylene chloride/methanol (50:1)] to obtain 1.70 g of light brown crystals. Recrystallization from isopropyl alcohol yielded light brown crystals with a melting point of 144.0-145.5°C.

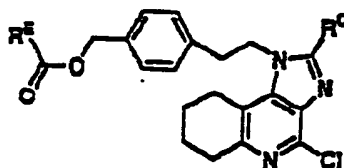
Elemental analysis: $C_{12}H_{14}ClN_2O_2$

Calculated: C, 68.32; H, 5.73; N, 9.96

Found: C, 68.32; H, 5.74; N, 9.98

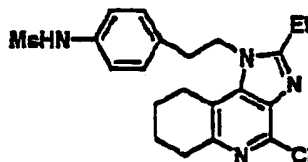
The compounds for Reference Examples 154-156 listed in Tables 37 and 38 were obtained by the same method as Reference Example 153.

Table 37



| | R ^E | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|----------------|----------------|----------------|--|---|
| Ref. Ex.154 | Me | Me | colorless crystals (iso-PrOH) mp: 150.5-152.5°C | C ₂₂ H ₁₄ ClN ₃ O ₂ Calc.: C, 66.41; H, 6.08; N, 10.56 Found: C, 66.30; H, 6.25; N, 10.63 |
| Ref. Ex.155 | Et | Et | colorless crystals (iso-PrOH-iso-Pr.O) mp: 128.0-129.0°C | C ₂₄ H ₁₆ ClN ₃ O ₂ Calc.: C, 67.67; H, 6.63; N, 9.87 Found: C, 67.57; H, 6.52; N, 9.91 |

Table 38



| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|---|
| Ref. Ex.156 | light brown crystals (iso-PrOH) mp: 187.0-189.0°C | C ₂₂ H ₁₄ ClN ₃ O ₂ S Calc.: C, 58.25; H, 5.82; N, 12.94 Found: C, 58.31; H, 5.98; N, 12.90 |

Reference Example 157

4-[2-(2-ethoxymethyl-4-hydroxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzenesulfonamide

Upon adding 23.7 ml of ethoxyacetic acid to 5.92 g of 4-[2-[(3-amino-2-chloroquinolin-4-yl)amino]ethyl]benzenesulfonamide, the mixture was stirred at 80-130°C for 6 hours. After the reaction, the precipitated crystals were filtered off and washed with methylene chloride to obtain 3.90 g of crystals. Recrystallization from a mixed solution of N,N-dimethylformamide and water yielded colorless crystals with a melting point of 300°C or higher.

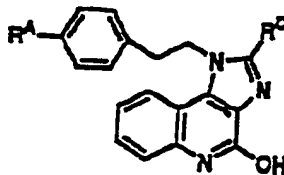
Elemental analysis: C₂₂H₁₇N₄O₄·1/2H₂O

Calculated: C, 58.52; H, 5.26; N, 13.00

Found: C, 58.41; H, 5.00; N, 12.75

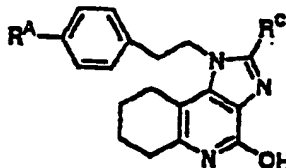
The compounds for Reference Examples 158-178 listed in Tables 39 to 46 were obtained by the same method as Reference Example 157.

Table 39



| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---------------------------------|---|---|---|
| Ref. Ex.158 | SO ₂ NH ₂ | iso-Pen | light brown crystals (DMF-H ₂ O) mp: ≥300°C | C ₁₈ H ₁₄ N ₂ O ₂ S·1/6H ₂ O Calc.: C, 62.56; H, 6.01; N, 12.69 Found: C, 62.27; H, 5.80; N, 12.57 |
| Ref. Ex.159 | SO ₂ NH ₂ | DF, | light brown crystals (DMF-H ₂ O) mp: ≥300°C | C ₁₈ H ₁₄ F ₂ N ₂ O ₂ S Calc.: C, 52.29; H, 3.46; N, 12.84 Found: C, 52.16; H, 3.38; N, 12.86 |
| Ref. Ex.160 | SO ₂ NH ₂ | CH ₂ CH ₂ CF ₃ | light brown crystals (DMF-H ₂ O) mp: 290.0-291.5°C, decomposition | C ₁₈ H ₁₄ F ₃ N ₂ O ₂ S Calc.: C, 54.31; H, 4.12; N, 12.06 Found: C, 54.33; H, 3.87; N, 12.01 |
| Ref. Ex.161 | SO ₂ NH ₂ | CH ₂ OH | faint brown crystals (DMF-H ₂ O) mp: 294.0-296.0°C | C ₁₈ H ₁₄ N ₂ O ₃ S Calc.: C, 57.28; H, 4.55; N, 14.06 Found: C, 57.17; H, 4.60; N, 14.06 |
| Ref. Ex.162 | SO ₂ NH ₂ | CH ₂ OMe | light brown crystals (EtOH) mp: 277.5-278.5°C | C ₁₈ H ₁₄ N ₂ O ₃ S·1/4H ₂ O Calc.: C, 57.61; H, 4.96; N, 13.44 Found: C, 57.52; H, 5.04; N, 13.34 |
| Ref. Ex.163 | NHMe | CH ₂ OEt | light brown crystals (MeOH) mp: 231.0-233.0°C | C ₁₈ H ₁₄ N ₂ O ₂ S Calc.: C, 59.98; H, 5.49; N, 12.72 Found: C, 60.00; H, 5.52; N, 12.68 |
| Ref. Ex.164 | SO ₂ NHMe | | light brown crystals (DMF-H ₂ O) mp: 288.0-289.0°C | C ₁₈ H ₁₄ N ₂ O ₃ S Calc.: C, 63.28; H, 5.54; N, 12.83 Found: C, 63.07; H, 5.41; N, 12.57 |
| Ref. Ex.165 | SO ₂ NHMe | CH ₂ OEt | light yellow crystals (DMF-H ₂ O) mp: 268.5-270.0°C | C ₁₈ H ₁₄ N ₂ O ₃ S Calc.: C, 59.98; H, 5.49; N, 12.72 Found: C, 60.09; H, 5.44; N, 12.90 |

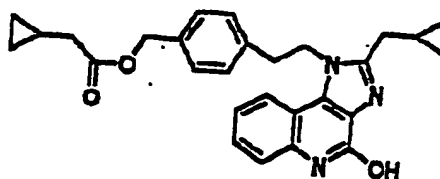
Table 40



| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---------------------------------|---------------------|--|---|
| Ref. Ex.166 | SO ₂ NH ₂ | CH ₂ OEt | light brown crystals (DMF-H ₂ O) mp: ≥300°C | C ₁₈ H ₁₄ N ₂ O ₃ S·1/3H ₂ O Calc.: C, 57.78; H, 6.16; N, 12.83 Found: C, 57.54; H, 6.16; N, 12.68 |

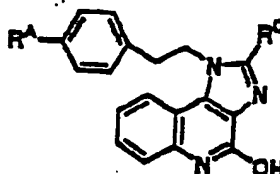
| | | | | |
|---------|-------|---------------------|--------------------|---|
| Ref. | | | colorless crystals | C ₁₂ H ₁₁ N ₃ O ₂ · 1/4H ₂ O |
| Ex. 167 | NMeBn | CH ₃ OEt | (THF) | Calc.: C, 73.31; H, 7.32; N, 11.79 |
| | | | mp: 235.0-238.5°C | Found: C, 73.43; H, 7.25; N, 11.92 |

Table 41



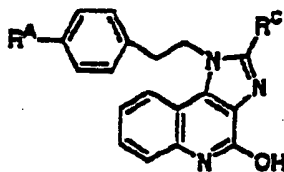
| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|--|--|
| Ref. Ex.168 | colorless needle-like crystals (AcOEt) mp: 186.0-186.5°C | $C_{27}H_{27}NO$ Calc.: C, 73.82; H, 6.42; N, 9.22 Found: C, 73.64; H, 6.39; N, 9.16 |

Table 42



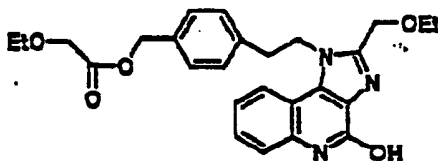
| | R ¹ | R ² | Properties |
|----------------|---------------------------------|----------------|--|
| Ref. Ex.169 | SO ₂ NH ₂ | n-Pen | light brown crystals NMR spectrum δ (DMSO-d ₆) ppm: 0.87(3H, t, J=7Hz), 1.15-1.40(4H, m), 1.63(2H, quintet, J=7Hz), 2.43(2H, t, J=7Hz), 3.20(2H, t, J=7Hz), 4.73(2H, t, J=7Hz), 7.21(2H, br-s), 7.29(2H, d, J=8Hz), 7.45(2H, t, J=8Hz), 7.50(1H, d, J=8Hz), 7.73(2H, d, J=8Hz), 8.07(1H, d, J=8Hz), 11.43(1H, br-s) IR spectrum V(KBr) cm ⁻¹ : 1660, 1336, 1162 |
| Ref. Ex.170 | SO ₂ NH ₂ | iso-Bu | yellowish brown crystals NMR spectrum δ (DMSO-d ₆) ppm: 0.89(6H, d, J=7Hz), 2.05-2.15(1H, m), 2.32(2H, d, J=7Hz), 3.18(2H, t, J=7Hz), 4.74(2H, t, J=7Hz), 7.23(2H, br-s), 7.29(2H, d, J=8.5Hz), 7.30-7.35(1H, m), 7.40-7.51(2H, m), 7.73(2H, d, J=8.5Hz), 8.05-8.10(1H, m), 11.4(1H, br-s) IR spectrum V(KBr) cm ⁻¹ : 1652, 1348, 1162 |
| Ref. Ex.171 | SO ₂ NH ₂ | | light yellow crystals NMR spectrum δ (DMSO-d ₆) ppm: 0.15-0.25(2H, m), 0.45-0.55(2H, m), 1.05-1.10(1H, m), 2.55-2.60(2H, m), 3.22(2H, t, J=7Hz), 4.82(2H, t, J=7Hz), 7.24(2H, br-s), 7.34(2H, d, J=8Hz), 7.35-7.40(1H, m), 7.50-7.60(2H, m), 7.74(2H, d, J=8Hz), 8.10-8.15(1H, m), 11.72(1H, br-s) IR spectrum V(KBr) cm ⁻¹ : 1656, 1346, 1164 |
| Ref. Ex.172 | NHMe | | colorless crystals NMR spectrum δ (DMSO-d ₆) ppm: 0.05-0.15(2H, m), 0.45-0.55(2H, m), 1.05-1.15(1H, m), 2.39(2H, d, J=7Hz), 2.91(3H, s), 3.07(2H, t, J=7Hz), 4.67(2H, t, J=7Hz), 7.02(2H, d, J=8.5Hz), 7.11(2H, d, J=8.5Hz), 7.28(1H, t, J=7.5Hz), 7.44(1H, t, J=7.5Hz), 7.49(1H, d, J=7.5Hz), 8.05(1H, d, J=7.5Hz), 9.54(1H, br-s), 11.41(1H, br-s) IR spectrum V(KBr) cm ⁻¹ : 1620, 1332, 1154 |

Table 43



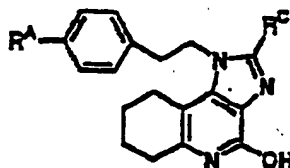
| | R ^A | R ^C | Properties |
|----------------|----------------------|--------------------|--|
| Ref. Ex.173 | SO ₂ NHMe | CH ₃ OH | light brown crystals NMR spectrum δ (DMSO-d ₆) ppm: 2.38(3H, s), 3.27(2H, t, J=7.5Hz), 4.42(2H, s), 4.87(2H, t, J=7.5Hz), 5.56(1H, br-s), 7.25-7.35(2H, m), 7.40(2H, d, J=8Hz), 7.40-7.55(2H, m), 7.69(2H, d, J=8Hz), 8.08(1H, d, J=8Hz), 11.44(1H, s) IR spectrum V(KBr) cm ⁻¹ : 1666, 1314, 1158 |

Table 44



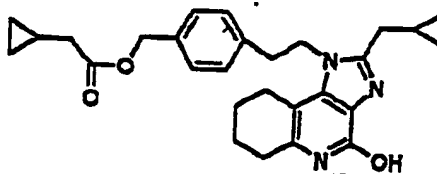
| | Properties |
|----------------|--|
| Ref. Ex.174 | light yellow crystals NMR spectrum δ (DMSO-d ₆) ppm: 1.10-1.20(6H, m), 3.16(2H, t, J=7Hz), 3.45-3.60(4H, m), 4.40(2H, s), 4.78(2H, t, J=7Hz), 5.05(2H, s), 5.13(2H, s), 7.20-7.25(2H, m), 7.30-7.35(3H, m), 7.45-7.55(2H, m), 8.08(1H, d, J=8Hz), 11.48(1H, s) IR spectrum V(KBr) cm ⁻¹ : 1680 Mass spectrum m/z: 463 (M ⁺) |

Table 45



| | R ^A | R ^C | Properties |
|----------------|---------------------------------|---------------------|---|
| Ref. Ex.175 | SO ₂ NH ₂ | Me | colorless crystals NMR spectrum δ (DMSO-d ₆) ppm: 1.65-1.80(4H, m), 2.21(3H, s), 2.45-2.60(2H, m), 2.75-2.85(2H, m), 3.07(2H, t, J=7.5Hz), 4.39(2H, t, J=7.5Hz), 7.23(2H, br-s), 7.30(2H, d, J=8Hz), 7.74(2H, d, J=8Hz), 10.65(1H, br-s) IR spectrum V(KBr) cm ⁻¹ : 3364, 3252, 1654, 1332, 1158 |
| Ref. Ex.176 | SO ₂ NH ₂ | Et | colorless crystals NMR spectrum δ (DMSO-d ₆) ppm: 1.21(3H, t, J=7.5Hz), 1.65-1.80(4H, m), 2.45-2.60(2H, m), 2.55(2H, q, J=7.5Hz), 2.75-2.90(2H, m), 3.05(2H, t, J=7.5Hz), 4.39(2H, t, J=7.5Hz), 7.22(2H, br-s), 7.30(2H, d, J=8.5Hz), 7.73(2H, d, J=8.5Hz), 10.67(1H, br-s) IR spectrum V(KBr) cm ⁻¹ : 3224, 3088, 1650, 1332, 1160 |
| Ref. Ex.177 | NHMe | CH ₃ OEt | colorless crystals NMR spectrum δ (DMSO-d ₆) ppm: 1.13(3H, t, J=7Hz), 1.60-1.80(4H, m), 2.45-2.60(2H, m), 2.80-2.90(2H, m), 2.94(3H, s), 3.01(2H, t, J=8Hz), 3.49(2H, q, J=7Hz), 4.41(2H, s), 4.45(2H, t, J=8Hz), 7.09(2H, d, J=8.5Hz), 7.15(2H, d, J=8.5Hz), 9.55(1H, br-s), 10.74(1H, br-s) IR spectrum V(KBr) cm ⁻¹ : 3464, 1652, 1330, 1148 |

Table 46



| | Properties |
|----------------|--|
| Ref. Ex.178 | colorless crystals NMR spectrum δ (DMSO-d ₆) ppm: 0.10-0.20(4H, m), 0.45-0.55(4H, m), 0.95-1.00(1H, m), 1.00-1.10(1H, m), 1.71(4H, br-s), 2.27(2H, d, J=6.5Hz), 2.43(2H, d, J=6.5Hz), 2.52(2H, br-s), 2.81(2H, br-s), 2.97(2H, t, J=7.5Hz), 4.37(2H, t, J=7.5Hz), 5.06(2H, s), 7.09(2H, d, J=8.5Hz), 7.27(2H, d, J=8.5Hz), 10.66(1H, br-s) IR spectrum V(KBr) cm ⁻¹ : 1736, 1660 |

Reference Example 179

4-[2-(4-chloro-2-ethoxymethyl-1H-imidazo[4,5-c]quinolin-1-

yl)ethyl]benzenesulfonamide

To a suspension containing 3.03 g of 4-[2-(2-ethoxymethyl-4-hydroxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzenesulfonamide, 1.5 ml of triethylamine and 30 ml of toluene there was added dropwise 2.8 ml of phosphorus oxychloride at room temperature, and then the mixture was stirred at 120°C for 5 hours. The reaction solution was poured into ice water, the precipitated crystals were filtered off, and the obtained crystals were purified by column chromatography [silica gel, methylene chloride/methanol (20:1)] to obtain 1.89 g of light brown crystals.

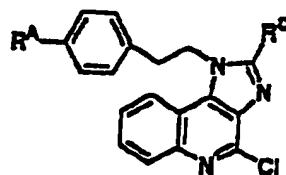
IR spectrum ν (KBr) cm^{-1} : 3360, 1332, 1160

Mass spectrum m/z : 444(M^+)

NMR spectrum δ (DMSO) ppm : 1.16(3H, t, $J=7\text{Hz}$), 3.30(2H, t, $J=8\text{Hz}$), 3.56(2H, q, $J=7\text{Hz}$), 4.59(2H, s), 4.99(2H, t, $J=8\text{Hz}$), 7.24(2H, br-s), 7.41(2H, d, $J=8\text{Hz}$), 7.77-7.82(4H, m), 8.11-8.13(1H, m), 8.45-8.47(1H, m)

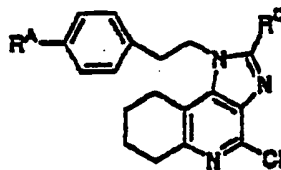
The compounds for Reference Examples 180-196 listed in Tables 47 to 51 were obtained by the same method as Reference Example 179.

Table 47



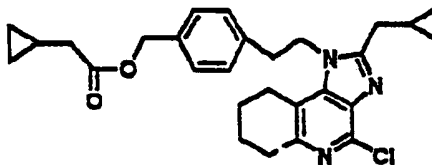
| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---------------------------------|---|---|---|
| Ref. Ex.180 | SO ₂ NH ₂ | n-Pen | light brown crystals (EtOH) mp: 212.0-213.0°C | C ₂₁ H ₁₄ ClN ₄ O ₂ S Calc.: C, 60.45; H, 5.51; N, 12.26 Found: C, 60.28; H, 5.46; N, 12.04 |
| Ref. Ex.181 | SO ₂ NH ₂ | iso-Pen | light yellow needle- like crystals (EtOH) mp: 240.0-241.5°C | C ₂₁ H ₁₄ ClN ₄ O ₂ S Calc.: C, 60.45; H, 5.51; N, 12.26 Found: C, 60.51; H, 5.53; N, 12.25 |
| Ref. Ex.182 | SO ₂ NH ₂ | | light brown crystals (DMF-H ₂ O) mp: 266.0-270.0°C | C ₂₁ H ₁₄ ClN ₄ O ₂ S·3/4H ₂ O Calc.: C, 58.14; H, 4.99; N, 12.33 Found: C, 58.17; H, 4.79; N, 12.49 |
| Ref. Ex.183 | SO ₂ NH ₂ | CF ₃ | light brown crystals (DMF-H ₂ O) mp: 253.0-254.0°C | C ₂₁ H ₁₂ ClF ₃ N ₄ O ₂ S Calc.: C, 50.17; H, 3.10; N, 12.32 Found: C, 49.93; H, 3.14; N, 12.35 |
| Ref. Ex.184 | SO ₂ NH ₂ | CH ₂ CH ₂ CF ₃ | yellowish brown crystals (DMF-H ₂ O) mp: 239.5-241.5°C decomposition | C ₂₁ H ₁₄ ClF ₃ N ₄ O ₂ S Calc.: C, 52.23; H, 3.76; N, 11.60 Found: C, 52.34; H, 3.94; N, 11.85 |
| Ref. Ex.185 | SO ₂ NH ₂ | CH ₂ OMe | light brown crystals (DMF-H ₂ O) mp: 234.5-235.5°C decomposition | C ₂₁ H ₁₄ ClN ₄ O ₂ S Calc.: C, 55.75; H, 4.44; N, 13.00 Found: C, 56.00; H, 4.17; N, 13.08 |
| Ref. Ex.186 | NHMe | | light brown crystals (AcOEt) mp: 205.0-206.0°C | C ₂₁ H ₁₄ ClN ₄ O ₂ S Calc.: C, 60.72; H, 5.10; N, 12.31 Found: C, 60.87; H, 5.14; N, 12.01 |
| Ref. Ex.187 | NHMe | CH ₂ OEt | faint brown crystals (EtOH) mp: 198.5-200.5°C | C ₂₁ H ₁₄ ClN ₄ O ₂ S Calc.: C, 57.57; H, 5.05; N, 12.21 Found: C, 57.59; H, 5.04; N, 12.15 |
| Ref. Ex.188 | SO ₂ NHMe | | light brown crystals (DMF) mp: 255.5-257.0°C | C ₂₁ H ₁₄ ClN ₄ O ₂ S Calc.: C, 60.72; H, 5.10; N, 12.31 Found: C, 60.62; H, 5.02; N, 12.26 |
| Ref. Ex.189 | SO ₂ NHMe | CH ₂ OEt | light yellow crystals (DMF-H ₂ O) mp: 214.0-215.5°C | C ₂₁ H ₁₄ ClN ₄ O ₂ S Calc.: C, 57.57; H, 5.05; N, 12.21 Found: C, 57.48; H, 4.90; N, 12.41 |

Table 48



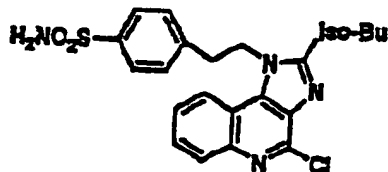
| | R¹ | R² | Properties (recrystallization solvent) | Elemental analysis |
|----------------|--------|--------|--|--|
| Ref. Ex.190 | SO,NH, | Me | light brown crystals (DMF-H₂O) mp: 283.0-286.0°C | C₁₆H₁₄ClN₂O.S·1/4H₂O Calc.: C, 55.74; H, 5.29; N, 13.68 Found: C, 55.65; H, 5.15; N, 13.68 |
| Ref. Ex.191 | SO,NH, | Et | light brown crystals (DMF-H₂O) mp: 271.0-273.0°C | C₁₈H₁₆ClN₂O.S·1/4H₂O Calc.: C, 56.73; H, 5.59; N, 13.23 Found: C, 56.51; H, 5.45; N, 13.37 |
| Ref. Ex.192 | SO,NH, | CH₃OEt | light yellow needle- like crystals (EtOH) mp: 208.0-209.5°C | C₁₈H₁₆ClN₂O.S Calc.: C, 55.18; H, 5.61; N, 12.48 Found: C, 55.86; H, 5.65; N, 12.22 |
| Ref. Ex.193 | NHMs | CH₃OEt | colorless needle-like crystals (EtOH) mp: 169.5-170.0°C | C₁₈H₁₆ClN₂O.S Calc.: C, 57.07; H, 5.88; N, 12.10 Found: C, 56.77; H, 5.80; N, 12.02 |

Table 49



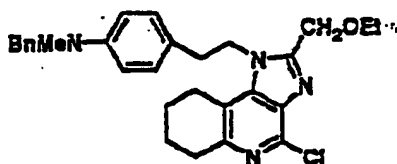
| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|---|
| Ref. Ex.194 | colorless crystals (Benzene-n-Hexane) mp: 109.0-110.5°C | C₂₃H₂₄ClN₂O Calc.: C, 70.35; H, 6.75; N, 8.79 Found: C, 70.18; H, 6.74; N, 8.88 |

Table 50



| Properties | |
|----------------|--|
| Ref. Ex.195 | brown crystals NMR spectrum δ (DMSO- d_6) ppm: 0.93(6H, d, $J=7\text{Hz}$), 2.10-2.20(1H, m), 2.47(2H, d, $J=7\text{Hz}$), 3.25(2H, t, $J=7\text{Hz}$), 4.91(2H, t, $J=7\text{Hz}$), 7.23(2H, br-s), 7.29(2H, d, $J=8.5\text{Hz}$), 7.73(2H, d, $J=8.5\text{Hz}$), 7.75-7.80(2H, m), 8.05-8.15(1H, m), 8.40-8.50(1H, m) IR spectrum V(KBr) cm^{-1} : 1332, 1160 |

Table 51



| Properties | |
|----------------|---|
| Ref. Ex.196 | brown liquid NMR spectrum δ (CDCl_3) ppm: 1.20(3H, t, $J=7\text{Hz}$), 1.80-2.00(4H, m), 2.97(2H, t, $J=7.5\text{Hz}$), 3.00-3.10(2H, m), 3.01(3H, s), 3.10-3.20(2H, m), 3.52(2H, q, $J=7\text{Hz}$), 4.43(2H, s), 4.52(2H, s), 4.57(2H, t, $J=7.5\text{Hz}$), 6.65(2H, d, $J=8.5\text{Hz}$), 6.85(2H, d, $J=8.5\text{Hz}$), 7.20(2H, d, $J=7.5\text{Hz}$), 7.24(1H, t, $J=7.5\text{Hz}$), 7.31(2H, t, $J=7.5\text{Hz}$) IR spectrum V(liq) cm^{-1} : 3424 Mass spectrum m/z : 488, 490(3:1, M^+) |

Reference Example 197

N-[4-[(2-(4-dibenzylamino)-2-ethoxymethyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]phenyl]acetamide

A mixture of 5.21 g of N-[4-[2-[(3-amino-2-dibenzylaminoquinolin-4-yl)amino]ethyl]phenyl]acetamide and 4.21 g of ethoxyacetic acid was stirred at 140°C for 10 hours. Ethyl acetate and a 10% sodium hydroxide aqueous solution were added to the reaction mixture for separation, and the aqueous layer was extracted with ethyl acetate. The ethyl acetate layers were combined, and after washing with saturated saline and dewatering,

the solvent was distilled off. The residue was purified by column chromatography [silica gel, ethyl acetate/n-hexane (1:2-1:1)] and washed with a mixed solution of ethyl acetate and isopropyl ether to obtain 2.35 g of light brown crystals. Recrystallization from ethyl acetate yielded colorless needle-like crystals with a melting point of 171.0-171.5°C.

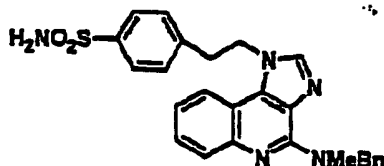
Elemental analysis: $C_{17}H_{17}N_3O_2$

Calculated: C, 76.13; H, 6.39; N, 12.00

Found: C, 76.23; H, 6.32; N, 11.98

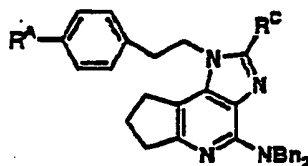
The compounds for Reference Examples 198-204 listed in Tables 52 to 56 were obtained by the same method as Reference Example 197.

Table 52



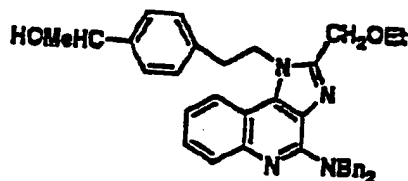
| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|---|
| Ref. Ex.198 | light yellow crystals (AcOEt) mp: 188.5-189.0°C | $C_{17}H_{17}N_3O_2S$ Calc.: C, 66.22; H, 5.34; N, 14.85 Found: C, 66.01; H, 5.35; N, 14.72 |

Table 53



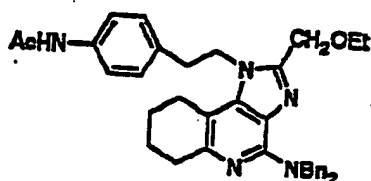
| | R ¹ | R ² | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---------------------------------|----------------|--|---|
| Ref. Ex.199 | NBn ₂ | H | light brown crystals (AcOEt) mp: 161.5-162.0°C | $C_{17}H_{17}N_3$ Calc.: C, 82.66; H, 6.63; N, 10.71 Found: C, 82.59; H, 6.76; N, 10.71 |
| Ref. Ex.200 | SO ₂ NH ₂ | H | colorless crystals (MeOH) mp: 160.0-161.0°C | $C_{17}H_{17}N_3O_2S \cdot 1/2H_2O$ Calc.: C, 68.11; H, 5.90; N, 12.81 Found: C, 68.20; H, 5.93; N, 12.77 |

Table 54



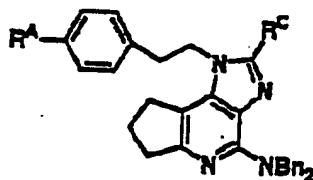
| Properties | |
|----------------|---|
| Ref. Ex.201 | <p>orange liquid</p> <p>NMR spectrum δ (CDCl₃) ppm: 1.17(3H, t, J=7Hz), 1.49(3H, d, J=6.5Hz), 1.78(1H, br-s), 3.27(2H, t, J=7.5Hz), 3.45(2H, q, J=7Hz), 4.39(2H, s), 4.81(2H, t, J=7.5Hz), 4.90(1H, q, J=6.5Hz), 5.43(4H, br-s), 7.14(2H, d, J=8Hz), 7.15-7.40(13H, m), 7.51(1H, t, J=8Hz), 7.86(1H, d, J=8Hz), 8.13(1H, d, J=8Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3420</p> |

Table 55



| Properties | |
|----------------|---|
| Ref. Ex.202 | <p>light brown liquid</p> <p>NMR spectrum δ (CDCl₃) ppm: 1.15(3H, t, J=7Hz), 1.89(4H, br-s), 2.17(3H, s), 2.84(2H, br-s), 3.05(2H, t, J=7.5Hz), 3.11(2H, br-s), 3.43(2H, q, J=6.5Hz), 4.36(2H, s), 4.52(2H, t, J=7.5Hz), 5.24(4H, s), 7.05(2H, d, J=8Hz), 7.15-7.35(10H, m), 7.41(2H, d, J=8Hz)</p> <p>IR spectrum V(liq) cm⁻¹: 3304, 1668, 1096</p> <p>Mass spectrum m/z: 587(M)</p> |

Table 56



| | R ^A | R ^C | Properties |
|----------------|------------------|---------------------|--|
| Ref. Ex.203 | NBn ₂ | Et | yellow liquid NMR spectrum δ (CDCl ₃) ppm: 1.22(3H, t, J=7.5Hz), 2.17(2H, quintet, J=7.5Hz), 2.47(2H, q, J=7.5Hz), 2.87(2H, t, J=7.5Hz), 2.91(2H, t, J=7.5Hz), 3.17(2H, t, J=7.5Hz), 4.21(2H, t, J=7.5Hz), 4.63(4H, s), 5.27(4H, s), 6.63(2H, d, J=8.5Hz), 6.84(2H, d, J=8.5Hz), 7.1-7.4(20H, m) Mass spectrum m/z: 681(M ⁺) |
| Ref. Ex.204 | NBn ₂ | CH ₃ OEt | brown liquid NMR spectrum δ (CDCl ₃) ppm: 1.14(3H, t, J=7Hz), 2.18(2H, quintet, J=7.5Hz), 2.92(2H, t, J=7.5Hz), 2.95(2H, t, J=7.5Hz), 3.21(2H, t, J=7.5Hz), 3.42(2H, q, J=7Hz), 4.35(2H, s), 4.35(2H, t, J=7.5Hz), 4.63(4H, s), 5.25(4H, s), 6.65(2H, d, J=8.5Hz), 6.90(2H, d, J=8.5Hz), 7.18(2H, t, J=7.5Hz), 7.20-7.30(14H, m), 7.32(4H, t, J=7.5Hz) |

Reference Example 205

4-[2-(2-acetoxymethyl-4-hydroxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzenesulfonamide

To 7.53 g of 4-[2-(4-hydroxy-2-hydroxymethyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzenesulfonamide there were added 225 ml of pyridine and 17.8 ml of acetic anhydride, and the mixture was stirred at room temperature for one hour. After concentrating the reaction solution under reduced pressure, water was added, and the precipitated crystals were filtered off and washed first with water and then with ethyl acetate to obtain 7.81 g of crystals. Recrystallization from a mixed solution of N,N-dimethylformamide and water yielded light brown crystals with a melting point of 275.0-276.0°C.

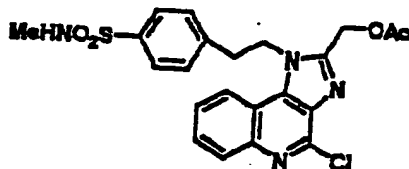
Elemental analysis: C₂₁H₂₀N₄O₃S

Calculated: C, 57.26; H, 4.58; N, 12.72

Found: C, 56.94; H, 4.50; N, 12.63

The compound for Reference Example 206 listed in Table 57 was obtained by the same method as Reference Example 205.

Table 57



| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|---|
| Ref. Ex.206 | light brown crystals (DMF-H ₂ O) mp: 242.0-244.0°C | C ₂₂ H ₂₁ N ₃ O ₄ S Calc.: C, 58.14; H, 4.88; N, 12.33 Found: C, 58.07; H, 4.59; N, 12.17 |

Reference Example 207

4-[2-(2-hydroxymethyl-4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzenesulfonamide

A mixture of 3.00 g of 4-[2-(2-acetoxymethyl-4-hydroxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzenesulfonamide and 45 ml of phosphorus oxychloride was refluxed for one hour. After cooling, the crystals were filtered off and washed with ethyl acetate to obtain 2.30 g of light brown crystals. After adding 4.71 g of phenol and 1.72 g of potassium hydroxide to the obtained light brown crystals, the mixture was stirred at 120°C for one hour. After cooling, 10% hydrochloric acid and ethyl acetate were added, filtering off of the insoluble portion was followed by separation, and the ethyl acetate layer was dewatered and concentrated under reduced pressure. Diethyl ether was added to the residue, and the precipitated crystals were filtered off to obtain 1.39 g of crystals. Recrystallization from a mixed solution of N,N-dimethylformamide and water yielded light brown crystals with a melting point of 261.0-263.0°C.

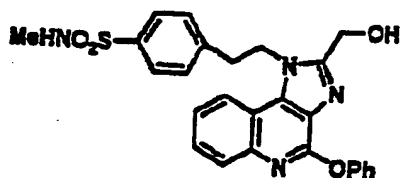
Elemental analysis: C₂₂H₂₁N₃O₄S

Calculated: C, 63.28; H, 4.67; N, 11.81

Found: C, 63.24; H, 4.58; N, 11.71

The compound for Reference Example 208 listed in Table 58 was obtained by the same method as Reference Example 207.

Table 58



| Ref. Ex.208 | Properties |
|----------------|---|
| | light brown crystals NMR spectrum δ (DMSO- d_6) ppm: 2.38(3H, d, $J=5\text{Hz}$), 3.34(2H, t, $J=7.5\text{Hz}$), 4.56(2H, d, $J=5.5\text{Hz}$), 5.02(2H, t, $J=7.5\text{Hz}$), 5.69(1H, t, $J=5.5\text{Hz}$), 7.25-7.31(4H, m), 7.43(2H, d, $J=8\text{Hz}$), 7.45-7.50(2H, m), 7.55-7.65(2H, m), 7.71(2H, d, $J=8\text{Hz}$), 7.70-7.75(1H, m), 8.35-8.37(1H, m) IR spectrum ν (KBr) cm^{-1} : 3464, 1666, 1316, 1162 |

Reference Example 209

4-[2-(4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzamide

To 1.65 g of 4-[2-(4-chloro-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzamide there were added 0.81 g of potassium hydroxide and 4.43 g of phenol, and the mixture was stirred at 120°C for 4.5 hours. After adding water and 10% hydrochloric acid to the reaction mixture to adjust the liquid to pH 8, ethyl acetate was added and the precipitated crystals were filtered off to obtain 1.29 g of light brown crystals. Recrystallization from ethanol yielded yellow needle-like crystals with a melting point of 265.0-266.0°C.

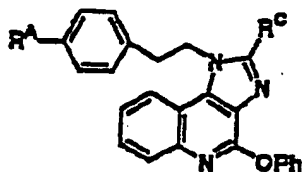
Elemental analysis: $\text{C}_{25}\text{H}_{20}\text{N}_4\text{O}_2$

Calculated: C, 73.51; H, 4.94; N, 13.72

Found: C, 73.33; H, 4.85; N, 13.43

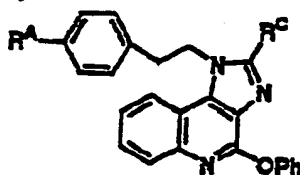
The compounds for Reference Examples 210-287 listed in Tables 59 to 71 were obtained by the same method as Reference Example 209.

Table 59



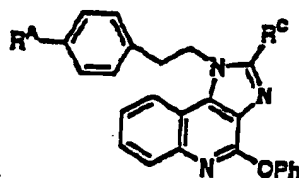
| | R ¹ | R ² | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---------------------------------|----------------|---|---|
| Ref. Ex.210 | CONHMe | H | faint violet crystals (EtOH) mp: 215.0-217.0°C | C ₂₁ H ₁₈ N ₂ O Calc.: C, 73.92; H, 5.25; N, 13.26 Found: C, 74.02; H, 5.13; N, 13.16 |
| Ref. Ex.211 | OH | H | faint brown crystals (EtOH) mp: 266.0-268.0°C | C ₂₁ H ₁₈ N ₂ O Calc.: C, 75.57; H, 5.02; N, 11.02 Found: C, 75.37; H, 4.72; N, 11.09 |
| Ref. Ex.212 | | H | colorless crystals (EtOH) mp: 193.0-195.0°C | C ₂₁ H ₁₈ N ₂ O Calc.: C, 74.48; H, 5.58; N, 9.31 Found: C, 74.42; H, 5.45; N, 9.38 |
| Ref. Ex.213 | SO ₂ NHEt | H | light brown crystals (DMF-H ₂ O) mp: 257.0-259.0°C | C ₂₁ H ₁₈ N ₂ O ₂ S Calc.: C, 66.08; H, 5.12; N, 11.86 Found: C, 66.11; H, 4.97; N, 12.12 |
| Ref. Ex.214 | SO ₂ NHnPr | H | colorless crystals (DMF-H ₂ O) mp: 231.5-235.0°C | C ₂₁ H ₁₈ N ₂ O ₂ S Calc.: C, 66.65; H, 5.39; N, 11.51 Found: C, 66.54; H, 5.32; N, 11.80 |
| Ref. Ex.215 | SO ₂ NMe | H | light reddish brown crystals (DMF-H ₂ O) mp: 204.5-205.5°C | C ₂₁ H ₁₈ N ₂ O ₂ S Calc.: C, 66.08; H, 5.12; N, 11.86 Found: C, 65.80; H, 4.91; N, 11.64 |
| Ref. Ex.216 | SO ₂ NH ₂ | H | light brown crystals (DMF-H ₂ O) mp: 260.0-260.5°C | C ₂₁ H ₁₈ N ₂ O ₂ S Calc.: C, 64.85; H, 4.54; N, 12.60 Found: C, 64.58; H, 4.27; N, 12.56 |
| Ref. Ex.217 | SO ₂ NH ₂ | Et | light brown crystals (CH ₃ CN) mp: 277.0-280.0°C | C ₂₁ H ₁₈ N ₂ O ₂ S Calc.: C, 66.08; H, 5.12; N, 11.86 Found: C, 65.83; H, 4.83; N, 11.75 |
| Ref. Ex.218 | SO ₂ NH ₂ | n-Pr | light brown crystals (DMF-H ₂ O) mp: 225.0-226.0°C | C ₂₁ H ₁₈ N ₂ O ₂ S Calc.: C, 66.65; H, 5.39; N, 11.51 Found: C, 66.57; H, 5.27; N, 11.56 |
| Ref. Ex.219 | SO ₂ NH ₂ | n-Bu | light yellow needle- like crystals (CH ₂ Cl ₂ -MeOH) mp: 233.5-234.5°C | C ₂₁ H ₁₈ N ₂ O ₂ S Calc.: C, 67.18; H, 5.64; N, 11.19 Found: C, 66.84; H, 5.57; N, 10.93 |
| Ref. Ex.220 | SO ₂ NH ₂ | n-Pen | light brown crystals (CH ₃ CN) mp: 168.5-169.5°C | C ₂₁ H ₁₈ N ₂ O ₂ S Calc.: C, 67.68; H, 5.88; N, 10.89 Found: C, 67.49; H, 5.71; N, 10.73 |
| Ref. Ex.221 | SO ₂ NH ₂ | iso- Pen | colorless needle-like crystals (CH ₃ CN) mp: 225.0-226.5°C | C ₂₁ H ₁₈ N ₂ O ₂ S Calc.: C, 67.68; H, 5.88; N, 10.89 Found: C, 67.42; H, 5.83; N, 10.78 |

Table 60



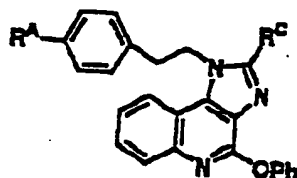
| | R ^a | R ^b | Properties (recrystallization solvent) | Elemental analysis |
|-----------------|---------------------------------|---|--|--|
| Ref. Ex. 222 | SO ₂ NH ₂ | | yellow crystals | $C_{18}H_{15}N_3O_2S \cdot Na$ Calc.: C, 64.60; H, 4.84; N, 10.76 Found: C, 64.92; H, 4.96; N, 10.87 |
| Ref. Ex. 223 | SO ₂ NH ₂ | CF ₃ | colorless crystals (DMF-H ₂ O) mp: 250.5-251.0°C | $C_{18}H_{13}F_3N_3O_2S$ Calc.: C, 58.59; H, 3.74; N, 10.93 Found: C, 58.38; H, 3.55; N, 10.83 |
| Ref. Ex. 224 | SO ₂ NH ₂ | CH ₂ CH ₂ CF ₃ | light brown crystals (DMF-H ₂ O) mp: 227.5-228.5°C | $C_{20}H_{17}F_3N_3O_2S$ Calc.: C, 59.99; H, 4.29; N, 10.36 Found: C, 60.10; H, 4.20; N, 10.30 |
| Ref. Ex. 225 | SO ₂ NH ₂ | CH ₂ OH | light brown crystals (DMF-H ₂ O) mp: 261.0-263.0°C | $C_{18}H_{17}N_3O_3S$ Calc.: C, 63.28; H, 4.67; N, 11.81 Found: C, 63.24; H, 4.58; N, 11.71 |
| Ref. Ex. 226 | SO ₂ NH ₂ | CH ₂ OMe | colorless crystals (DMF-H ₂ O) mp: 247.0-249.0°C | $C_{19}H_{17}N_3O_3S$ Calc.: C, 63.92; H, 4.95; N, 11.47 Found: C, 63.63; H, 4.80; N, 11.44 |
| Ref. Ex. 227 | SO ₂ NH ₂ | CH ₂ OEt | light yellow crystals (DMF-H ₂ O) mp: 257.0-258.0°C | $C_{20}H_{19}N_3O_3S$ Calc.: C, 64.52; H, 5.21; N, 11.15 Found: C, 64.29; H, 5.13; N, 10.94 |
| Ref. Ex. 228 | SO ₂ NHMe | H | colorless crystals (DMF-H ₂ O) mp: 261.0-262.5°C | $C_{17}H_{15}N_3O_2S$ Calc.: C, 65.48; H, 4.84; N, 12.22 Found: C, 65.28; H, 4.64; N, 11.92 |
| Ref. Ex. 229 | SO ₂ NHMe | Me | colorless crystals (DMF-H ₂ O) mp: 253.5-254.0°C | $C_{18}H_{17}N_3O_2S \cdot 1/4 H_2O$ Calc.: C, 65.46; H, 5.18; N, 11.74 Found: C, 65.57; H, 4.95; N, 11.84 |
| Ref. Ex. 230 | SO ₂ NHMe | Et | light reddish brown crystals (DMF-H ₂ O) mp: 235.5-236.0°C | $C_{19}H_{19}N_3O_2S$ Calc.: C, 66.65; H, 5.39; N, 11.51 Found: C, 66.31; H, 5.24; N, 11.35 |
| Ref. Ex. 231 | SO ₂ NHMe | n-Pr | light reddish brown crystals (DMF-H ₂ O) mp: 220.0-221.5°C | $C_{20}H_{21}N_3O_2S$ Calc.: C, 67.18; H, 5.64; N, 11.19 Found: C, 67.19; H, 5.55; N, 11.01 |
| Ref. Ex. 232 | SO ₂ NHMe | n-Bu | light brown crystals (EtOH) mp: 203.0-203.5°C | $C_{21}H_{23}N_3O_2S$ Calc.: C, 67.68; H, 5.88; N, 10.89 Found: C, 67.69; H, 5.73; N, 10.92 |
| Ref. Ex. 233 | SO ₂ NHMe | | colorless crystals (CH ₃ CN) mp: 225.0-226.0°C | $C_{18}H_{15}N_3O_2S$ Calc.: C, 67.95; H, 5.51; N, 10.93 Found: C, 67.95; H, 5.40; N, 10.89 |

Table 61



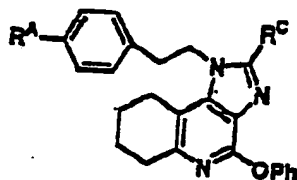
| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|----------------|--------------------|---------------------|--|---|
| Ref. Ex.234 | CH ₃ OH | H | light brown plate crystals (EtOH) mp: 187.0-189.0°C | C ₂₁ H ₁₉ N ₃ O ₂ Calc.: C, 75.93; H, 5.35; N, 10.63 Found: C, 76.10; H, 5.11; N, 10.71 |
| Ref. Ex.235 | CH ₃ OH | Et | light brown crystals (DMF-H ₂ O) mp: 220.0-222.0°C | C ₂₄ H ₂₃ N ₃ O ₂ Calc.: C, 76.57; H, 5.95; N, 9.92 Found: C, 76.28; H, 6.03; N, 10.01 |
| Ref. Ex.236 | CH ₃ OH | n-Bu | light brown crystals (EtOH) mp: 149.5-150.5°C | C ₂₇ H ₂₅ N ₃ O ₂ Calc.: C, 77.14; H, 6.47; N, 9.31 Found: C, 76.99; H, 6.40; N, 9.14 |
| Ref. Ex.237 | NHMs | H | colorless crystals (CH ₂ Cl ₂ -MeOH) mp: 256.5-257.5°C | C ₂₁ H ₁₉ N ₃ O ₂ S Calc.: C, 65.48; H, 4.84; N, 12.22 Found: C, 65.34; H, 4.76; N, 12.40 |
| Ref. Ex.238 | NHMs | Me | colorless crystals (CH ₂ CN) mp: 246.0-247.0°C | C ₂₁ H ₁₉ N ₃ O ₂ S Calc.: C, 66.08; H, 5.12; N, 11.86 Found: C, 66.35; H, 5.11; N, 11.80 |
| Ref. Ex.239 | NHMs | Et | colorless crystals (DMF-H ₂ O) mp: 267.0-268.0°C | C ₂₃ H ₂₁ N ₃ O ₂ S Calc.: C, 66.65; H, 5.39; N, 11.51 Found: C, 66.81; H, 5.32; N, 11.54 |
| Ref. Ex.240 | NHMs | n-Pr | light brown crystals (DMF-H ₂ O) mp: 223.0-225.5°C | C ₂₅ H ₂₃ N ₃ O ₂ S Calc.: C, 67.18; H, 5.64; N, 11.19 Found: C, 67.02; H, 5.55; N, 11.15 |
| Ref. Ex.241 | NHMs | n-Bu | light brown crystals (DMF-H ₂ O) mp: 160.5-162.5°C | C ₂₇ H ₂₅ N ₃ O ₂ S Calc.: C, 67.68; H, 5.88; N, 10.89 Found: C, 67.50; H, 5.77; N, 10.84 |
| Ref. Ex.242 | NHMs | | grayish brown crystals (AcOEt) mp: 226.0-227.0°C | C ₂₄ H ₂₃ N ₃ O ₂ S Calc.: C, 67.95; H, 5.51; N, 10.93 Found: C, 67.66; H, 5.44; N, 10.68 |
| Ref. Ex.243 | NHMs | CH ₃ OEt | faint brown crystals (DMF-H ₂ O) mp: 223.0-225.0°C | C ₂₃ H ₂₁ N ₃ O ₂ S Calc.: C, 65.10; H, 5.46; N, 10.84 Found: C, 64.91; H, 5.33; N, 10.82 |
| Ref. Ex.244 | NHTs | H | light brown crystals (DMF-H ₂ O) mp: 242.0-242.5°C | C ₂₁ H ₁₉ N ₃ O ₂ S Calc.: C, 69.64; H, 4.90; N, 10.48 Found: C, 69.47; H, 4.68; N, 10.44 |
| Ref. Ex.245 | NHAc | H | colorless prism crystals (EtOH) mp: 234.5-235.0°C | C ₂₁ H ₁₉ N ₃ O ₂ Calc.: C, 73.92; H, 5.25; N, 13.26 Found: C, 73.84; H, 5.15; N, 13.19 |

Table 62



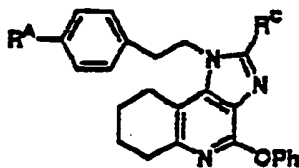
| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|----------------|------------------|----------------|---|--|
| Ref. Ex.246 | NHAc | Me | faint yellow plate crystals (MeOH) mp: 241.0-243.0°C | $C_{17}H_{17}NO_2 \cdot 1/2H_2O$ Calc.: C, 72.79; H, 5.66; N, 12.58 Found: C, 72.74; H, 5.76; N, 12.53 |
| Ref. Ex.247 | NHAc | Et | light brown crystals (MeOH) mp: 247.5-248.0°C | $C_{19}H_{19}NO_2$ Calc.: C, 74.65; H, 5.82; N, 12.44 Found: C, 74.71; H, 5.84; N, 12.46 |
| Ref. Ex.248 | NHAc | n-Bu | colorless plate crystals (AcOEt) mp: 176.5-177.0°C | $C_{21}H_{21}NO_2$ Calc.: C, 75.29; H, 6.32; N, 11.71 Found: C, 75.38; H, 6.32; N, 11.85 |
| Ref. Ex.249 | NMeAc | H | colorless crystals (AcOEt) mp: 144.0-145.0°C | $C_{17}H_{17}NO_2$ Calc.: C, 74.29; H, 5.54; N, 12.84 Found: C, 74.10; H, 5.83; N, 12.82 |
| Ref. Ex.250 | NMeAc | Me | colorless crystals (iso-PrOH) mp: 205.0-206.5°C | $C_{17}H_{17}NO_2 \cdot 1/2H_2O$ Calc.: C, 73.18; H, 5.92; N, 12.19 Found: C, 73.18; H, 5.67; N, 12.12 |
| Ref. Ex.251 | NMeAc | Et | faint brown needle-like crystals (AcOEt) mp: 99.0-102.0°C | $C_{19}H_{19}NO_2 \cdot 1/2H_2O$ Calc.: C, 73.55; H, 6.17; N, 11.83 Found: C, 73.72; H, 6.19; N, 11.85 |
| Ref. Ex.252 | NMeAc | n-Bu | colorless needle-like crystals (AcOEt) mp: 164.5-165.0°C | $C_{21}H_{21}NO_2$ Calc.: C, 75.58; H, 6.55; N, 11.37 Found: C, 75.62; H, 6.60; N, 11.31 |
| Ref. Ex.253 | NBn ₂ | n-Bu | colorless crystals (AcOEt) mp: 157.0-157.5°C | $C_{21}H_{21}NO$ Calc.: C, 81.79; H, 6.54; N, 9.08 Found: C, 81.93; H, 6.56; N, 9.09 |
| Ref. Ex.254 | CHMeNHAc | Et | light brown crystals (DMF-H ₂ O) mp: 182.0-184.0°C | $C_{19}H_{19}NO_2 \cdot 1/4H_2O$ Calc.: C, 74.59; H, 6.36; N, 11.60 Found: C, 74.80; H, 6.23; N, 11.63 |

Table 63



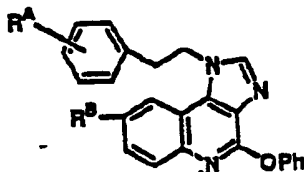
| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---------------------------------|---------------------|---|---|
| Ref. Ex.255 | SO ₂ NH ₂ | H | light reddish brown crystals (DMF-H ₂ O) mp: 235.5-236.5°C | C ₂₄ H ₁₉ N ₃ O ₂ S Calc.: C, 64.27; H, 5.39; N, 12.49 Found: C, 64.06; H, 5.19; N, 12.54 |
| Ref. Ex.256 | SO ₂ NH ₂ | Et | colorless crystals (EtOH) mp: 249.0-250.0°C | C ₂₆ H ₂₁ N ₃ O ₂ S Calc.: C, 65.52; H, 5.92; N, 11.76 Found: C, 65.57; H, 6.03; N, 11.63 |
| Ref. Ex.257 | SO ₂ NH ₂ | CH ₃ OEt | light brown plate crystals (CH ₂ Cl ₂) mp: 250.0-252.0°C | C ₂₆ H ₂₁ N ₃ O ₂ S Calc.: C, 64.01; H, 5.97; N, 11.06 Found: C, 63.99; H, 6.06; N, 10.70 |
| Ref. Ex.258 | CH ₂ OH | H | light brown crystals (iso-PrOH) mp: 188.5-190.5°C | C ₂₄ H ₁₉ N ₃ O Calc.: C, 75.16; H, 6.31; N, 10.52 Found: C, 74.89; H, 6.19; N, 10.34 |
| Ref. Ex.259 | CH ₂ OH | Me | light brown crystals (iso-PrOH) mp: 201.0-202.0°C | C ₂₅ H ₂₀ N ₃ O Calc.: C, 74.70; H, 6.63; N, 10.05 Found: C, 74.73; H, 6.58; N, 9.86 |
| Ref. Ex.260 | CH ₂ OH | Et | light brown crystals (MeOH) mp: 203.5-205.0°C | C ₂₆ H ₂₁ N ₃ O Calc.: C, 75.85; H, 6.84; N, 9.83 Found: C, 75.62; H, 6.94; N, 9.77 |
| Ref. Ex.261 | CH ₂ OH | | light brown crystals (CH ₂ Cl ₂ -Et ₂ O) mp: 173.5-174.5°C | C ₂₆ H ₂₁ N ₃ O Calc.: C, 76.79; H, 6.89; N, 9.26 Found: C, 76.51; H, 6.61; N, 8.96 |
| Ref. Ex.262 | NHMs | H | light brown crystals (DMF-H ₂ O) mp: 242.0-243.5°C | C ₂₄ H ₁₉ N ₃ O ₂ S · 1/2H ₂ O Calc.: C, 63.67; H, 5.77; N, 11.88 Found: C, 63.86; H, 5.68; N, 11.90 |
| Ref. Ex.263 | NHMs | Et | colorless crystals (MeOH) mp: 242.0-244.0°C | C ₂₆ H ₂₁ N ₃ O ₂ S Calc.: C, 66.10; H, 6.16; N, 11.42 Found: C, 66.26; H, 6.20; N, 11.33 |
| Ref. Ex.264 | NHMs | n-Bu | colorless crystals (AcOEt) mp: 187.0-188.0°C | C ₂₈ H ₂₃ N ₃ O ₂ S Calc.: C, 67.15; H, 6.61; N, 10.80 Found: C, 67.01; H, 6.40; N, 10.82 |
| Ref. Ex.265 | NHMs | CH ₃ OEt | light brown crystals (EtOH) mp: 189.0-189.5°C | C ₂₆ H ₂₁ N ₃ O ₂ S Calc.: C, 64.59; H, 6.20; N, 10.76 Found: C, 64.53; H, 6.20; N, 10.63 |
| Ref. Ex.266 | NHAc | H | light yellow crystals (DMF-H ₂ O) mp: 245.0-246.5°C | C ₂₄ H ₁₉ N ₃ O Calc.: C, 73.22; H, 6.14; N, 13.13 Found: C, 72.99; H, 6.15; N, 13.06 |
| Ref. Ex.267 | NHAc | Me | colorless needle-like crystals (EtOH) mp: 260.5-261.0°C | C ₂₅ H ₂₀ N ₃ O Calc.: C, 73.61; H, 6.41; N, 12.72 Found: C, 73.45; H, 6.37; N, 12.73 |

Table 64



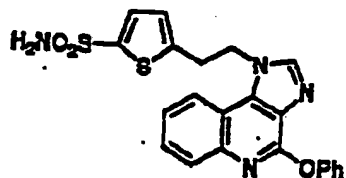
| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|----------------|----------------|----------------|--|---|
| Ref. Ex.268 | NHAc | n-Bu | light brown crystals (AcOEt) mp: 227.0-228.0°C | C ₂₄ H ₂₀ N ₂ O ₂ Calc.: C, 74.66; H, 7.10; N, 11.61 Found: C, 74.57; H, 7.12; N, 11.48 |
| Ref. Ex.269 | NMeAc | H | colorless crystals (MeOH-H ₂ O) mp: 145.5-147.0°C | C ₂₄ H ₂₀ N ₂ O ₂ Calc.: C, 73.61; H, 6.41; N, 12.72 Found: C, 73.58; H, 6.52; N, 12.66 |
| Ref. Ex.270 | NMeAc | Me | colorless prism crystals (AcOEt) mp: 181.5-182.0°C | C ₂₄ H ₂₀ N ₂ O ₂ Calc.: C, 73.98; H, 6.65; N, 12.33 Found: C, 73.97; H, 6.59; N, 12.43 |
| Ref. Ex.271 | NMeAc | Et | faint brown crystals (AcOEt) mp: 161.0-162.5°C | C ₂₄ H ₂₀ N ₂ O ₂ Calc.: C, 74.33; H, 6.88; N, 11.96 Found: C, 74.35; H, 6.96; N, 11.85 |
| Ref. Ex.272 | CHMeNHAc | H | colorless crystals (EtOH) mp: 236.0-236.5°C | C ₂₄ H ₂₀ N ₂ O ₂ Calc.: C, 73.98; H, 6.65; N, 12.33 Found: C, 73.98; H, 6.88; N, 12.32 |

Table 65



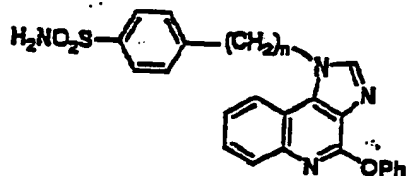
| | R ^A | R ^B | Properties (recrystallization solvent) | Elemental analysis |
|----------------|-----------------------------------|----------------|---|---|
| Ref. Ex.273 | o-SO ₂ NH ₂ | H | colorless crystals (DMF-H ₂ O) mp: 248.0-249.0°C | C ₂₄ H ₁₈ N ₂ O ₂ S Calc.: C, 64.85; H, 4.54; N, 12.60 Found: C, 64.57; H, 4.40; N, 12.46 |
| Ref. Ex.274 | m-SO ₂ NH ₂ | H | light brown crystals (DMF-H ₂ O) mp: 255.5-257.0°C | C ₂₄ H ₁₈ N ₂ O ₂ S·1/4H ₂ O Calc.: C, 64.20; H, 4.60; N, 12.48 Found: C, 64.01; H, 4.36; N, 12.64 |
| Ref. Ex.275 | p-SO ₂ NH ₂ | Cl | light brown crystals (DMF-H ₂ O) mp: 295.0-296.0°C | C ₂₄ H ₁₇ ClN ₂ O ₂ S Calc.: C, 60.19; H, 4.00; N, 11.70 Found: C, 59.89; H, 3.81; N, 11.70 |

Table 66



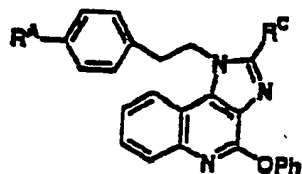
| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|--|---|
| Ref. Ex.276 | colorless crystals (CH ₂ Cl ₂ -MeOH) mp: 240.5-241.5°C | $C_{17}H_{11}N_3O_2S$ Calc.: C, 58.65; H, 4.03; N, 12.44 Found: C, 58.44; H, 3.75; N, 12.43 |

Table 67



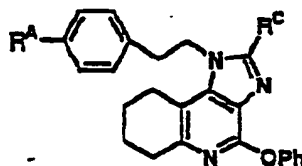
| | n | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|---|---|
| Ref. Ex.277 | 1 | light brown crystals (DMF-H ₂ O) mp: 249.0-253.5°C | $C_{17}H_{11}N_3O_2S$ Calc.: C, 64.17; H, 4.21; N, 13.01 Found: C, 63.91; H, 4.13; N, 12.74 |
| Ref. Ex.278 | 3 | light pink crystals (DMF-H ₂ O) mp: 255.0-255.5°C | $C_{21}H_{15}N_3O_2S$ Calc.: C, 65.48; H, 4.84; N, 12.22 Found: C, 65.44; H, 4.84; N, 12.11 |

Table 68



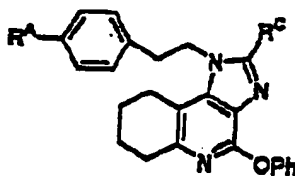
| | R ^A | R ^C | Properties |
|----------------|---------------------------------|---------------------|--|
| Ref. Ex.279 | SO ₂ NH ₂ | Me | light brown crystals NMR spectrum δ (DMSO-d ₆) ppm: 2.28(3H, s), 3.29(2H, t, J=7Hz), 4.88(2H, t, J=7Hz), 7.24(2H, br-s), 7.20-7.35(3H, m), 7.32(2H, d, J=8Hz), 7.40-7.50(2H, m), 7.55-7.65(2H, m), 7.70-7.80(1H, m), 7.75(2H, d, J=8Hz), 8.30-8.40(1H, m) IR spectrum V(KBr) cm ⁻¹ : 3324, 3152, 1312, 1156 |
| Ref. Ex.280 | SO ₂ NHMe | CH ₂ OEt | colorless crystals NMR spectrum δ (DMSO-d ₆) ppm: 1.16(3H, t, J=7Hz), 2.39(3H, d, J=5Hz), 3.30(2H, t, J=7.5Hz), 3.56(2H, q, J=7Hz), 4.56(2H, s), 5.00(2H, t, J=7.5Hz), 7.28(1H, q, J=7Hz), 7.30-7.35(2H, m), 7.40-7.50(4H, m), 7.55-7.65(2H, m), 7.70-7.75(3H, m), 8.35-8.40(1H, m) IR spectrum V(KBr) cm ⁻¹ : 1320, 1158 Mass spectrum m/z: 516(M ⁺) |

Table 69



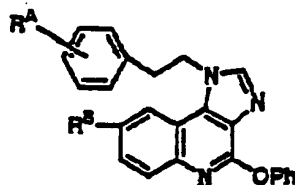
| | R ^A | R ^C | Properties |
|----------------|---------------------------------|----------------|--|
| Ref. Ex.281 | SO ₂ NH ₂ | Me | colorless crystals NMR spectrum δ (DMSO-d ₆) ppm: 1.70-1.90(4H, m), 2.31(3H, s), 2.68(2H, t, J=5.5Hz), 3.10(2H, t, J=5.5Hz), 3.12(2H, t, J=7.5Hz), 4.53(2H, t, J=7.5Hz), 7.08(2H, d, J=8Hz), 7.12(1H, t, J=8Hz), 7.33(2H, d, J=8Hz), 7.36(2H, t, J=8Hz), 7.75(2H, d, J=8Hz) IR spectrum V(liq) cm ⁻¹ : 3328, 1316, 1160 Mass spectrum m/z: 462(M ⁺) |

Table 70



| | R ¹ | R ² | Properties |
|----------------|----------------|---------------------|--|
| Ref. Ex.282 | NHMs | Me | light brown crystals NMR spectrum δ (CDCl ₃) ppm: 1.80-2.00(4H, m), 2.16(3H, s), 2.82(2H, t, J=6Hz), 2.92(3H, s), 3.04(2H, t, J=7Hz), 3.10(2H, t, J=7Hz), 4.46(2H, t, J=7Hz), 6.88(2H, d, J=8.5Hz), 7.05-7.18(5H, m), 7.28-7.32(2H, m), 7.61(1H, br-s) IR spectrum V(liq) cm ⁻¹ : 3432, 1338, 1158 Mass spectrum m/z: 476(M ⁺) |
| Ref. Ex.283 | NHAc | Et | light brown crystals NMR spectrum δ (DMSO-d ₆) ppm: 1.24(3H, t, J=7.5Hz), 1.75-1.85(4H, m), 2.02(3H, s), 2.63(2H, q, J=7.5Hz), 2.66(2H, t, J=6Hz), 2.96(2H, t, J=7.5Hz), 3.10(2H, t, J=6Hz), 4.46(2H, t, J=7.5Hz), 7.02(2H, d, J=8.5Hz), 7.10(2H, d, J=8.5Hz), 7.12(1H, t, J=8.5Hz), 7.37(2H, t, J=8.5Hz), 7.47(2H, d, J=8.5Hz), 9.78(1H, m) IR spectrum V(KBr) cm ⁻¹ : 1690, 1600, 1264 |
| Ref. Ex.284 | NMeAc | n-Bu | yellowish orange liquid NMR spectrum δ (CDCl ₃) ppm: 0.92(3H, t, J=7.5Hz), 1.38(2H, sextet, J=7.5Hz), 1.78(2H, quintet, J=7.5Hz), 1.80-1.90(4H, m), 1.85(3H, br-s), 2.51(2H, t, J=7.5Hz), 2.80(2H, t, J=6Hz), 3.07(2H, t, J=7Hz), 3.10(2H, t, J=6Hz), 3.24(3H, s), 4.50(2H, t, J=7Hz), 7.05(2H, d, J=8Hz), 7.12(2H, d, J=8Hz), 7.13(1H, t, J=8Hz), 7.25(2H, d, J=8Hz), 7.34(2H, t, J=8Hz) IR spectrum V(liq) cm ⁻¹ : 3464, 1662 Mass spectrum m/z: 496(M ⁺) |
| Ref. Ex.285 | NMeBn | CH ₃ OEt | brown liquid NMR spectrum δ (CDCl ₃) ppm: 1.19(3H, t, J=7Hz), 1.80-1.95(4H, m), 2.75-2.90(2H, m), 2.90-3.10(2H, m), 3.01(3H, s), 3.10-3.20(2H, m), 3.52(2H, q, J=7Hz), 4.44(2H, s), 4.52(2H, s), 4.57(2H, t, J=7.5Hz), 6.67(2H, d, J=8.5Hz), 6.90(2H, d, J=8.5Hz), 7.05-7.40(10H, m) IR spectrum V(liq) cm ⁻¹ : 3432 Mass spectrum m/z: 546(M ⁺) |

Table 71



| | R ^A | R ^B | Properties (recrystallization solvent) |
|----------------|-----------------------------------|----------------|--|
| Ref. Ex.286 | p-SO ₂ NH ₂ | Me | colorless crystals NMR spectrum δ (DMSO-d ₆) ppm: 2.56(3H, s), 3.33(2H, t, J=7.5Hz), 5.01(2H, t, J=7.5Hz), 7.22(2H, br-s), 7.20-7.30(3H, m), 7.37(2H, d, J=8Hz), 7.40-7.50(3H, m), 7.63(1H, d, J=8.5Hz), 7.75(2H, d, J=8Hz), 8.08(1H, s), 8.11(1H, s) IR spectrum ν (KBr) cm ⁻¹ : 1304, 1164 Mass spectrum m/z: 458(M ⁺) |
| Ref. Ex.287 | p-SO ₂ NH ₂ | OMe | grayish brown crystals NMR spectrum δ (DMSO-d ₆) ppm: 3.36(2H, t, J=7Hz), 3.95(3H, s), 5.04(2H, t, J=7Hz), 7.20-7.30(4H, m), 7.22(2H, br-s), 7.38(2H, d, J=8Hz), 7.45(1H, t, J=8Hz), 7.45(1H, d, J=8Hz), 7.66(1H, d, J=2.5Hz), 7.68(1H, d, J=8Hz), 7.75(1H, d, J=8Hz), 7.75(2H, d, J=8Hz), 8.10(1H, s) IR spectrum ν (KBr) cm ⁻¹ : 3356, 1328, 1164 Mass spectrum m/z: 474(M ⁺) |

Reference Example 288

4-[2-(2-n-butyl-4-phenoxy-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzenesulfonamide

(1) 4-[2-(2-n-butyl-4-chloro-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinolin-1-yl)ethyl-N-(1-ethoxypentylidene)benzenesulfonamide

To 3.04 g of 4-[2-[(3-amino-2-chloro-5,6,7,8-tetrahydroquinolin-4-yl)amino]ethyl]benzenesulfonamide there was added 12 ml of triethyl orthovalerate, and the mixture was stirred at 120-140°C for 25 hours. After adding n-hexane and removing the triethyl orthovalerate by decantation, the residue was stirred at 140°C for 19 hours. The mixture was purified by column chromatography [silica gel, methylene chloride/methanol (100:1)] to obtain 1.67 g of light brown crystals.

(2) 4-[2-(2-n-butyl-4-phenoxy-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzenesulfonamide

To 1.35 g of 4-[2-(2-n-butyl-4-chloro-6,7,8,9-tetrahydro-1H-imidazo[4,5-c]quinolin-1-yl)ethyl-N-(1-ethoxypentylidene)benzenesulfonamide there were added 0.43 g of potassium

hydroxide and 2.33 g of phenol, and the mixture was stirred at 120°C for 5 hours. After adding water and a 10% sodium hydroxide aqueous solution to the reaction mixture to adjust the liquid to pH 10, methylene chloride was added for extraction. After washing the extract first with a 10% sodium hydroxide aqueous solution, water and then with saturated saline and dewatering, the methylene chloride was distilled off. The residue was purified by column chromatography [silica gel, methylene chloride/methanol (100:1-30:1)] to obtain 0.68 g of faint brown crystals. Recrystallization from ethyl acetate yielded colorless crystals with a melting point of 224.5-225.5°C.

Elemental analysis: $C_{22}H_{21}N_4O_3S$

Calculated: C, 66.64; H, 6.39; N, 11.10

Found: C, 66.43; H, 6.41; N, 10.84

Reference Example 289

4-[2-(2-cyclopropylmethyl-4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl alcohol

(1) 4-[2-(4-chloro-2-cyclopropylmethyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl cyclopropylacetate

To 1.33 g of 4-[2-(2-cyclopropylmethyl-4-hydroxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl cyclopropylacetate there was added 20 ml of phosphorus oxychloride, and the mixture was stirred at 120°C for one hour. The reaction solution was poured into water, and methylene chloride was added for extraction. After washing the extract first with water and then with saturated saline and dewatering, the solvent was distilled off. The residue was purified by column chromatography [silica gel, methylene chloride/methanol (100:1-30:1)] to obtain 0.36 g of colorless crystals.

(2) 4-[2-(2-cyclopropylmethyl-4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl alcohol

To 0.25 g of 4-[2-(4-chloro-2-cyclopropylmethyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl cyclopropylacetate there were added 0.09 g of potassium hydroxide and 0.50 g of phenol, and the mixture was stirred at 120°C for 4 hours. After the reaction, water, a 10% sodium hydroxide aqueous solution and

ethyl acetate were added, and the mixture was stirred while cooling on ice. The precipitated crystals were filtered off to obtain 0.14 g of faint brown crystals. Recrystallization from ethyl acetate yielded 0.10 g of colorless crystals with a melting point of 185.0-185.5°C.

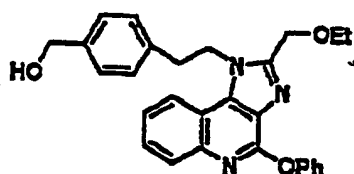
Elemental analysis: $C_{22}H_{17}N_3O_2$

Calculated: C, 77.48; H, 6.05; N, 9.35

Found: C, 77.22; H, 6.09; N, 9.11

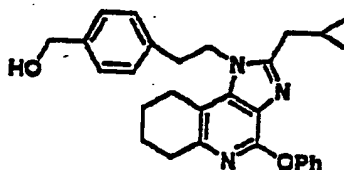
The compounds for Reference Examples 290-291 listed in Tables 72 and 73 were obtained by the same method as Reference Example 289.

Table 72



| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|--|--|
| Ref. Ex.290 | colorless crystals (AcOEt) mp: 184.5-185.0°C | $C_{22}H_{17}N_3O_2$ Calc.: C, 74.15; H, 6.00; N, 9.27 Found: C, 74.13; H, 6.22; N, 9.25 |

Table 73



| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|--|
| Ref. Ex.291 | light brown crystals (CH ₂ Cl ₂ -Et ₂ O) mp: 173.5-174.5°C | $C_{23}H_{19}N_3O_2$ Calc.: C, 76.79; H, 6.89; N, 9.26 Found: C, 76.51; H, 6.61; N, 8.96 |

Reference Example 292

4-[2-[2-(2-methylpropyl)-4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl]ethyl]benzenesulfonamide

(1) 4-[2-[4-hydroxy-2-(2-methylpropyl)-1H-imidazo[4,5-c]quinolin-1-yl]ethyl]benzenesulfonamide

To 8.0 g of 4-[2-[(3-amino-2-chloroquinolin-4-yl)amino]ethyl]benzenesulfonamide there was added 11.6 ml of isovaleric acid, and the mixture was stirred at 130°C for 24 hours. The precipitated crystals were filtered off and washed with methylene chloride to obtain 9.31 g of crystals.

(2) 4-[2-[4-chloro-2-(2-methylpropyl)-1H-imidazo[4,5-c]quinolin-1-yl]ethyl]benzenesulfonamide

To 9.00 g of 4-[2-[4-hydroxy-2-(2-methylpropyl)-1H-imidazo[4,5-c]quinolin-1-yl]ethyl]benzenesulfonamide there was added 135 ml of phosphorus oxychloride, and the mixture was stirred at 120°C for 9 hours. The reaction solution was concentrated under reduced pressure, ethyl acetate was added, and the precipitated crystals were filtered off to obtain 5.10 g of crystals.

(3) 4-[2-[2-(2-methylpropyl)-4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl]ethyl]benzenesulfonamide

To 4.80 g of 4-[2-[4-chloro-2-(2-methylpropyl)-1H-imidazo[4,5-c]quinolin-1-yl]ethyl]benzenesulfonamide there were added 1.86 g of potassium hydroxide and 10.2 g of phenol, and the mixture was stirred at 120°C for 5 hours. After adding water and 10% hydrochloric acid to the reaction mixture to adjust the liquid to pH 8, ethyl acetate was added and the precipitated crystals were filtered off to obtain 2.16 g of light brown crystals. Recrystallization from ethyl acetate yielded light brown needle-like crystals with a melting point of 221.0-222.0°C.

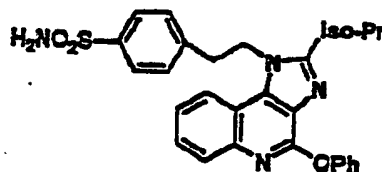
Elemental analysis: $C_{22}H_{21}N_4O_2S$

Calculated: C, 67.18; H, 5.64; N, 11.19

Found: C, 67.08; H, 5.47; N, 11.40

The compound for Reference Example 293 listed in Table 74 was obtained by the same method as Reference Example 292.

Table 74



| | Properties (recrystallization solvent) | Elemental analysis |
|----------------|---|--|
| Ref. Ex.293 | light yellow needle-like crystals (CH ₂ CN) mp: 261.0-263.0°C | C ₂₂ H ₁₈ N ₄ O Calc.: C, 66.65; H, 5.39; N, 11.51 Found: C, 66.51; H, 5.24; N, 11.53 |

Reference Example 294

1-[2-(4-cyanophenyl)ethyl]-4-phenoxy-1H-imidazo[4,5-c]quinoline

After dissolving 1.33 g of 4-[2-(4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzamide in 33 ml of N,N-dimethylformamide, 1.05 ml of pyridine and 0.92 ml of trifluoroacetic anhydride were added while stirring on ice, and stirring on ice was continued for 30 minutes. After adding 100 ml of ice water and 20 ml of diethyl ether to the reaction solution and stirring, the precipitated crystals were filtered off to obtain 0.89 g of crystals. Recrystallization from ethyl acetate yielded light yellow needle-like crystals with a melting point of 196.0-198.0°C.

Elemental analysis: C₂₂H₁₈N₄O

Calculated: C, 76.91; H, 4.65; N, 14.35

Found: C, 76.97; H, 4.35; N, 14.45

Reference Example 295

4-[2-(4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl] benzoic acid

To 2.31 g of ethyl 4-[2-(4-chloro-1H-imidazo[4,5-c]quinolin-1-yl)ethyl] benzoate there were added 5.67 g of phenol and 2.02 g of potassium hydroxide, and the mixture was stirred at 120°C for 3 hours. After adding water and 10% hydrochloric acid to the reaction mixture to adjust the liquid to pH 8, ethyl acetate was added and the precipitated crystals

were filtered off to obtain 2.29 g of crystals.

Recrystallization from a mixed solution of N,N-dimethylformamide and water yielded colorless crystals with a melting point of 265.0-267.0°C.

Elemental analysis: $C_{17}H_{11}N_3O$

Calculated: C, 73.34; H, 4.68; N, 10.26

Found: C, 73.34; H, 4.38; N, 10.38

Example 1

4-[2-(4-amino-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzamide

To 1.09 g of 4-[2-(4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzamide there was added 9.87 g of ammonium acetate, and the mixture was stirred at 140°C for 5 hours. After adding a 10% sodium hydroxide aqueous solution to the reaction mixture to adjust the liquid to pH 8, the precipitated crystals were filtered off and washed with water to obtain 0.82 g of light brown crystals. Recrystallization from ethanol yielded light brown crystals with a melting point of 267.0-268.0°C.

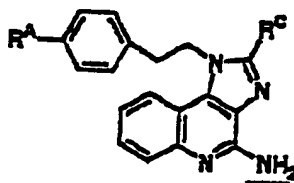
Elemental analysis: $C_{17}H_{11}N_3O$

Calculated: C, 68.87; H, 5.17; N, 21.13

Found: C, 68.58; H, 4.94; N, 20.87

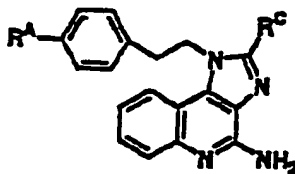
The compounds for Examples 2-50 listed in Tables 75 to 78 were obtained by the same method as Example 1.

Table 75



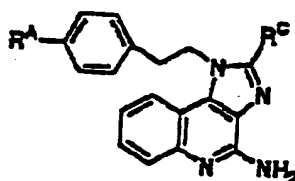
| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|--------|----------------------------------|----------------|--|---|
| Ex. 2 | CONHMe | H | faint brown crystals (MeOH) mp: 264.5-266.0°C | C ₁₇ H ₁₄ N ₂ O Calc.: C, 69.55; H, 5.54; N, 20.28 Found: C, 69.69; H, 5.43; N, 20.04 |
| Ex. 3 | OH | H | faint yellow needle-like crystals (EtOH) mp: 257.0-259.0°C | C ₁₇ H ₁₄ N ₂ O Calc.: C, 71.04; H, 5.30; N, 18.41 Found: C, 70.76; H, 5.04; N, 18.32 |
| Ex. 4 | CN | H | yellow crystals (DMF) mp: 301.0-303.0°C | C ₁₇ H ₁₂ N ₃ Calc.: C, 72.83; H, 4.82; N, 22.35 Found: C, 72.87; H, 4.57; N, 22.32 |
| Ex. 5 | COOH | H | faint brown crystals (reprecipitated) mp: 2300°C | C ₁₇ H ₁₄ N ₂ O · 1/3H ₂ O Calc.: C, 67.45; H, 4.96; N, 16.56 Found: C, 67.38; H, 4.71; N, 16.51 |
| Ex. 6 | SO ₂ NHEt | H | light yellow crystals (DMF-H ₂ O) mp: 207.5-209.5°C | C ₁₇ H ₁₆ N ₂ O ₂ S Calc.: C, 60.74; H, 5.35; N, 17.71 Found: C, 60.88; H, 5.26; N, 17.57 |
| Ex. 7 | SO ₂ NH-n-Pr | H | colorless crystals (DMF-H ₂ O) mp: 199.0-200.0°C | C ₁₉ H ₁₈ N ₂ O ₂ S Calc.: C, 61.59; H, 5.66; N, 17.10 Found: C, 61.47; H, 5.56; N, 17.33 |
| Ex. 8 | SO ₂ NMe ₂ | H | faint yellow needle-like crystals (DMF) mp: 297.5-298.5°C | C ₁₇ H ₁₆ N ₂ O ₂ S Calc.: C, 60.74; H, 5.35; N, 17.71 Found: C, 60.44; H, 5.49; N, 17.55 |
| Ex. 9 | SO ₂ NH ₂ | H | light brown crystals (DMF) mp: 298.5-299.0°C | C ₁₇ H ₁₄ N ₂ O ₂ S Calc.: C, 58.84; H, 4.66; N, 19.06 Found: C, 58.59; H, 4.66; N, 18.95 |
| Ex. 10 | SO ₂ NH ₂ | Me | light brown crystals (DMF-H ₂ O) mp: 274.0-275.0°C | C ₁₈ H ₁₆ N ₂ O ₂ S · 1/4H ₂ O Calc.: C, 59.13; H, 5.09; N, 18.15 Found: C, 59.17; H, 5.41; N, 18.10 |
| Ex. 11 | SO ₂ NH ₂ | Et | light yellowish brown crystals (DMF-EtOH) mp: 283.0-284.0°C | C ₁₉ H ₁₈ N ₂ O ₂ S Calc.: C, 60.74; H, 5.35; N, 17.71 Found: C, 60.43; H, 5.21; N, 17.41 |
| Ex. 12 | SO ₂ NH ₂ | n-Pr | light brown needle-like crystals (EtOH) mp: 242.5-244.0°C | C ₂₁ H ₂₀ N ₂ O ₂ S Calc.: C, 61.59; H, 5.66; N, 17.10 Found: C, 61.47; H, 5.56; N, 16.81 |
| Ex. 13 | SO ₂ NH ₂ | n-Bu | light yellow needle-like crystals (EtOH) mp: 257.0-258.0°C | C ₂₂ H ₂₂ N ₂ O ₂ S · 1/4H ₂ O Calc.: C, 61.73; H, 6.00; N, 16.36 Found: C, 61.93; H, 6.08; N, 16.12 |
| Ex. 14 | SO ₂ NH ₂ | n-Pen | light brown crystals (EtOH) mp: 244.0-244.5°C | C ₂₄ H ₂₄ N ₂ O ₂ S Calc.: C, 63.13; H, 6.22; N, 16.01 Found: C, 63.31; H, 6.29; N, 16.04 |

Table 76



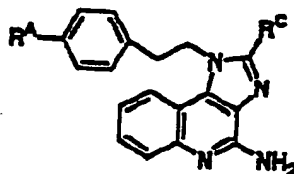
| | R ¹ | R ² | Properties (recrystallization solvent) | Elemental analysis |
|--------|---------------------------------|---|--|---|
| Ex. 15 | SO ₂ NH ₂ | iso-Pr | colorless needle-like crystals (CH ₃ CN-EtOH) mp: 265.5-266.0°C | C ₂₁ H ₁₄ N ₄ O ₂ S·1/5H ₂ O Calc.: C, 61.06; H, 5.71; N, 16.95 Found: C, 60.76; H, 5.62; N, 16.78 |
| Ex. 16 | SO ₂ NH ₂ | iso-Bu | light brown crystals (CH ₂ Cl ₂ -MeOH) mp: 232.0-234.0°C | C ₂₂ H ₁₆ N ₄ O ₂ S Calc.: C, 62.39; H, 5.95; N, 16.54 Found: C, 62.57; H, 5.95; N, 16.35 |
| Ex. 17 | SO ₂ NH ₂ | iso-Pen | colorless crystals (DMF-H ₂ O) mp: 249.5-253.5°C | C ₂₃ H ₁₈ N ₄ O ₂ S Calc.: C, 63.13; H, 6.22; N, 16.01 Found: C, 62.92; H, 6.38; N, 15.87 |
| Ex. 18 | SO ₂ NH ₂ | | light yellow needle-like crystals (MeOH) mp: 245.5-248.5°C | C ₂₁ H ₁₄ N ₄ O ₂ S Calc.: C, 62.69; H, 5.50; N, 16.61 Found: C, 62.52; H, 5.33; N, 16.50 |
| Ex. 19 | SO ₂ NH ₂ | CF ₃ | colorless crystals (DMF-H ₂ O) mp: 286.5-287.0°C | C ₁₉ H ₁₀ F ₃ N ₄ O ₂ S Calc.: C, 52.41; H, 3.70; N, 16.08 Found: C, 52.38; H, 3.66; N, 15.87 |
| Ex. 20 | SO ₂ NH ₂ | CH ₂ CH ₂ CF ₃ | light brown crystals (DMF-H ₂ O) mp: 248.5-249.0°C | C ₂₂ H ₁₆ F ₃ N ₄ O ₂ S Calc.: C, 54.42; H, 4.35; N, 15.11 Found: C, 54.13; H, 4.49; N, 14.91 |
| Ex. 21 | SO ₂ NH ₂ | CH ₂ OH | faint yellow crystals (EtOH-H ₂ O) mp: 256.0-258.0°C | C ₂₁ H ₁₆ N ₄ O ₂ S·1/3H ₂ O Calc.: C, 56.56; H, 4.91; N, 17.36 Found: C, 56.87; H, 4.66; N, 17.55 |
| Ex. 22 | SO ₂ NH ₂ | CH ₂ OMe | colorless crystals (DMF) mp: 248.0-249.0°C | C ₂₂ H ₁₈ N ₄ O ₂ S Calc.: C, 58.38; H, 5.14; N, 17.02 Found: C, 58.50; H, 5.03; N, 16.76 |
| Ex. 23 | SO ₂ NH ₂ | CH ₂ OEt | colorless crystals (DMF-H ₂ O) mp: 272.5-274.5°C | C ₂₃ H ₂₀ N ₄ O ₂ S Calc.: C, 59.28; H, 5.45; N, 16.46 Found: C, 59.07; H, 5.36; N, 16.16 |
| Ex. 24 | SO ₂ NHMe | H | colorless crystals (DMF-H ₂ O) mp: 244.0-245.0°C | C ₂₁ H ₁₆ N ₄ O ₂ S Calc.: C, 59.83; H, 5.02; N, 18.36 Found: C, 59.83; H, 4.94; N, 18.27 |
| Ex. 25 | SO ₂ NHMe | Me | colorless crystals (DMF-H ₂ O) mp: 259.5-260.5°C | C ₂₂ H ₁₈ N ₄ O ₂ S Calc.: C, 60.74; H, 5.35; N, 17.71 Found: C, 60.88; H, 5.33; N, 17.43 |
| Ex. 26 | SO ₂ NHMe | Et | colorless crystals (DMF) mp: 262.0-264.0°C | C ₂₃ H ₂₀ N ₄ O ₂ S Calc.: C, 61.59; H, 5.66; N, 17.10 Found: C, 61.69; H, 5.65; N, 16.86 |

Table 77



| | R ^A | R ^S | Properties (recrystallization solvent) | Elemental analysis |
|--------|----------------------|---------------------|--|---|
| Ex. 27 | SO ₂ NHMe | n-Pr | colorless crystals (DMF) mp: 233.5-234.5°C | C ₁₈ H ₁₆ N ₂ O ₂ S Calc.: C, 62.39; H, 5.95; N, 16.54 Found: C, 62.36; H, 5.91; N, 16.24 |
| Ex. 28 | SO ₂ NHMe | n-Bu | light brown crystals (MeOH) mp: 225.5-226.5°C | C ₂₀ H ₁₈ N ₂ O ₂ S Calc.: C, 63.13; H, 6.22; N, 16.01 Found: C, 63.04; H, 6.25; N, 15.81 |
| Ex. 29 | SO ₂ NHMe | CH ₂ OH | faint yellow plate crystals (MeOH) mp: ≥300°C | C ₁₇ H ₁₄ N ₂ O ₃ S·HCl·1/4H ₂ O Calc.: C, 53.09; H, 5.01; N, 15.48 Found: C, 53.09; H, 5.20; N, 15.18 |
| Ex. 30 | SO ₂ NHMe | | faint brown crystals (DMF) mp: 231.0-232.0°C | C ₁₉ H ₁₆ N ₂ O ₂ S Calc.: C, 63.43; H, 5.79; N, 16.08 Found: C, 63.44; H, 5.79; N, 15.95 |
| Ex. 31 | SO ₂ NHMe | CH ₂ OEt | colorless crystals (DMF-H ₂ O) mp: 239.0-240.5°C | C ₁₉ H ₁₈ N ₂ O ₃ S Calc.: C, 60.12; H, 5.73; N, 15.93 Found: C, 59.98; H, 5.75; N, 15.78 |
| Ex. 32 | CH ₂ OH | H | light brown crystals (EtOH) mp: 223.0-225.5°C | C ₁₇ H ₁₄ N ₂ O Calc.: C, 71.68; H, 5.70; N, 17.60 Found: C, 71.84; H, 5.48; N, 17.36 |
| Ex. 33 | CH ₂ OH | Et | colorless crystals (MeOH) mp: 215.5-217.0°C | C ₁₈ H ₁₆ N ₂ O Calc.: C, 72.81; H, 6.40; N, 16.17 Found: C, 72.94; H, 6.44; N, 16.17 |
| Ex. 34 | CH ₂ OH | n-Bu | light brown crystals (MeOH) mp: 289.0-289.5°C | C ₂₀ H ₁₈ N ₂ O·HCl Calc.: C, 67.22; H, 6.62; N, 13.63 Found: C, 66.99; H, 6.89; N, 13.62 |
| Ex. 35 | CH ₂ OH | | light brown prism crystals (MeOH) mp: 2289.0°C, decomposed | C ₁₉ H ₁₆ N ₂ O·HCl·1/2H ₂ O Calc.: C, 66.10; H, 6.27; N, 13.41 Found: C, 66.25; H, 6.06; N, 13.55 |
| Ex. 36 | CH ₂ OH | CH ₂ OEt | colorless crystals (EtOH) mp: 241.0-242.0°C | C ₁₉ H ₁₈ N ₂ O·HCl Calc.: C, 63.99; H, 6.10; N, 13.57 Found: C, 64.13; H, 6.10; N, 13.37 |
| Ex. 37 | NHMe | H | colorless crystals (AcOEt) mp: 229.5-230.5°C | C ₁₇ H ₁₄ N ₂ O ₂ S Calc.: C, 59.83; H, 5.02; N, 18.36 Found: C, 59.57; H, 4.94; N, 18.20 |
| Ex. 38 | NHMe | Me | colorless crystals (CH ₃ CN-EtOH) mp: 228.0-229.0°C | C ₁₈ H ₁₆ N ₂ O ₂ S Calc.: C, 60.74; H, 5.35; N, 17.71 Found: C, 60.77; H, 5.34; N, 17.47 |

Table 78



| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|--------|------------------|---------------------|--|--|
| Ex. 39 | NHMs | Et | colorless prism crystals (MeOH) mp: 180.5-181.5°C | C ₂₁ H ₁₈ N ₄ O ₅ ·HCl·3/2H ₂ O Calc.: C, 53.32; H, 5.75; N, 14.81 Found: C, 53.39; H, 5.72; N, 14.82 |
| Ex. 40 | NHMs | n-Pr | light brown crystals (iso-PrOH) mp: 250.5-253.5°C | C ₂₄ H ₂₀ N ₄ O ₅ ·HCl Calc.: C, 57.44; H, 5.70; N, 15.22 Found: C, 57.18; H, 5.63; N, 14.99 |
| Ex. 41 | NHMs | n-Bu | light brown crystals (MeOH) mp: 250.5-253.5°C | C ₂₆ H ₂₂ N ₄ O ₅ ·HCl Calc.: C, 58.28; H, 5.95; N, 14.77 Found: C, 58.25; H, 5.85; N, 14.79 |
| Ex. 42 | NHMs | | colorless crystals (MeOH) mp: 235.0-235.5°C | C ₂₄ H ₂₀ N ₄ O ₅ ·HCl Calc.: C, 58.53; H, 5.55; N, 14.84 Found: C, 58.44; H, 5.41; N, 14.82 |
| Ex. 43 | NHMs | CH ₃ OEt | faint brown crystals (EtOH) mp: 218.0-220.0°C | C ₂₁ H ₁₈ N ₄ O ₅ Calc.: C, 60.12; H, 5.73; N, 15.93 Found: C, 59.85; H, 5.63; N, 15.69 |
| Ex. 44 | NHTs | H | light brown crystals (DMF-H ₂ O) mp: 236.5-237.5°C | C ₂₁ H ₁₈ N ₄ O ₅ Calc.: C, 65.63; H, 5.07; N, 15.31 Found: C, 65.44; H, 4.92; N, 15.11 |
| Ex. 45 | NHAc | H | colorless crystals (CH ₂ Cl ₂ -MeOH) mp: 247.0-248.0°C | C ₂₁ H ₁₈ N ₄ O·1/4H ₂ O Calc.: C, 68.65; H, 5.61; N, 20.01 Found: C, 68.59; H, 5.43; N, 20.00 |
| Ex. 46 | NHAc | Me | colorless crystals (EtOH-H ₂ O) mp: 2290°C, decomposed | C ₂₁ H ₁₈ N ₄ O·HCl Calc.: C, 63.71; H, 5.60; N, 17.69 Found: C, 63.61; H, 5.64; N, 17.78 |
| Ex. 47 | NHAc | Et | colorless crystals (MeOH-H ₂ O) mp: 293.5-294.5°C, decomposed | C ₂₃ H ₂₀ N ₄ O·HCl Calc.: C, 64.46; H, 5.90; N, 17.08 Found: C, 64.52; H, 6.03; N, 17.06 |
| Ex. 48 | NHAc | n-Bu | colorless crystals (CH ₂ Cl ₂ -MeOH) mp: 2300°C | C ₂₅ H ₂₂ N ₄ O·HCl Calc.: C, 65.82; H, 6.58; N, 15.89 Found: C, 65.63; H, 6.44; N, 15.99 |
| Ex. 49 | NBn ₃ | n-Bu | colorless crystals (AcOEt) mp: 177.0-178.0°C | C ₂₄ H ₂₂ N ₄ Calc.: C, 80.11; H, 6.91; N, 12.98 Found: C, 79.93; H, 6.85; N, 12.75 |
| Ex. 50 | CHMeNHAc | Et | colorless crystals (MeOH) mp: 154.0-155.5°C | C ₂₁ H ₁₈ N ₄ O·1/2H ₂ O Calc.: C, 70.22; H, 6.87; N, 17.06 Found: C, 70.46; H, 6.78; N, 17.05 |

Example 51

4-[2-(4-amino-2-methyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl alcohol

(1) 4-[2-(4-chloro-2-methyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl alcohol

To 2.57 g of 4-[2-[(3-amino-2-chloroquinolin-4-yl)amino]ethyl]benzyl alcohol there was added 7.2 ml of triethyl

orthoacetate, and the mixture was stirred at 120-140°C for 28 hours. After adding n-hexane to the reaction mixture and removing it by decantation, the residue was purified by column chromatography [silica gel, methylene chloride/methanol (1:0-30:1)] to obtain 1.66 g of light yellow crystals.

(2) 4-[2-(2-methyl-4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl alcohol

To 1.50 g of 4-[2-(4-chloro-2-methyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl alcohol there were added 0.73 g of potassium hydroxide and 4.02 g of phenol, and the mixture was stirred at 120°C for 6 hours. After adding water and a 10% sodium hydroxide aqueous solution to the reaction mixture to adjust the liquid to pH 10, methylene chloride was added for extraction. The methylene chloride layer was washed first with a 10% sodium hydroxide aqueous solution, water and then with saturated saline, and after dewatering, the solvent was distilled off under reduced pressure to obtain 1.20 g of light brown crystals.

(3) 4-[2-(4-amino-2-methyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl alcohol

To 1.00 g of 4-[2-(2-methyl-4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzyl alcohol there was added 4.52 g of ammonium acetate, and the mixture was stirred at 140°C for 6 hours. After the reaction, a 10% sodium hydroxide aqueous solution was added to adjust the liquid to pH 8, and then extraction was performed with a mixed solution of methylene chloride and methanol (10:1). The organic layer was concentrated under reduced pressure, 3.8 ml of methanol and 0.2 ml of a 2 N sodium hydroxide aqueous solution were added to the residue, and the mixture was stirred at 50°C for one hour. The reaction solution was stirred on ice to obtain 0.26 g of crystals. Recrystallization from ethanol yielded colorless crystals with a melting point of 236.0-237.0°C.

Elemental analysis: $C_{20}H_{20}N_4O$

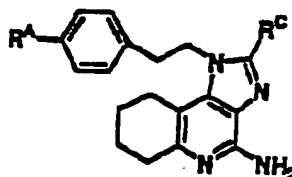
Calculated: C, 72.27; H, 6.06; N, 16.86

Found: C, 72.05; H, 6.07; N, 16.64

The compounds for Examples 52-79 listed in Tables 79 to 84

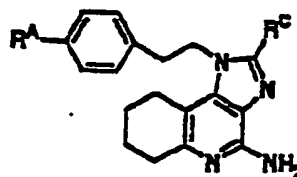
were obtained by the same method as Example 1.

Table 79



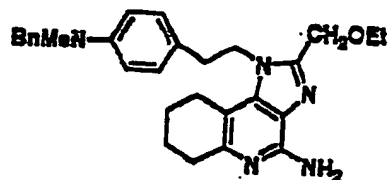
| | R ^a | R ^b | Properties (recrystallization solvent) | Elemental analysis |
|--------|---------------------------------|---------------------|---|---|
| Ex. 52 | SO ₂ NH ₂ | H | light brown crystals (DMF-H ₂ O) mp: 292.5-294.0°C | C ₁₈ H ₁₄ N ₂ O ₂ S-1/8H ₂ O Calc.: C, 57.85; H, 5.73; N, 18.74 Found: C, 57.73; H, 5.48; N, 18.49 |
| Ex. 53 | SO ₂ NH ₂ | Me | colorless crystals (MeOH) mp: 261.5-263.0°C | C ₁₉ H ₁₆ N ₂ O ₂ S-3/4H ₂ O Calc.: C, 57.19; H, 6.19; N, 17.55 Found: C, 57.39; H, 5.95; N, 17.27 |
| Ex. 54 | SO ₂ NH ₂ | Et | colorless crystals (MeOH) mp: 281.0-283.0°C | C ₂₁ H ₁₈ N ₂ O ₂ S-1/2H ₂ O Calc.: C, 58.80; H, 6.41; N, 17.14 Found: C, 58.59; H, 6.15; N, 17.17 |
| Ex. 55 | SO ₂ NH ₂ | n-Bu | light brown crystals (EtOH) mp: 240.0-241.0°C | C ₂₃ H ₂₀ N ₂ O ₂ S Calc.: C, 61.80; H, 6.84; N, 16.38 Found: C, 61.52; H, 6.85; N, 16.17 |
| Ex. 56 | SO ₂ NH ₂ | CH ₂ OEt | light brown plate crystals (EtOH) mp: 254.5-256.0°C | C ₂₁ H ₁₈ N ₂ O ₂ S Calc.: C, 58.72; H, 6.34; N, 16.30 Found: C, 59.02; H, 6.43; N, 16.16 |
| Ex. 57 | CH ₂ OH | H | colorless crystals (EtOH) mp: 223.5-225.0°C | C ₁₈ H ₁₄ N ₂ O Calc.: C, 70.78; H, 6.88; N, 17.38 Found: C, 70.90; H, 6.84; N, 17.30 |
| Ex. 58 | CH ₂ OH | Me | light brown crystals (iso-PrOH) mp: 230.0-231.0°C | C ₁₉ H ₁₆ N ₂ O Calc.: C, 71.40; H, 7.19; N, 16.65 Found: C, 71.31; H, 7.37; N, 16.40 |
| Ex. 59 | CH ₂ OH | Et | colorless crystals (EtOH) mp: 222.5-224.5 | C ₂₁ H ₁₈ N ₂ O Calc.: C, 71.97; H, 7.48; N, 15.99 Found: C, 71.70; H, 7.48; N, 16.05 |

Table 80



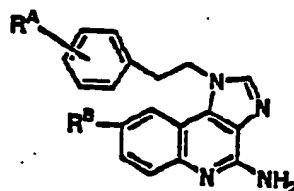
| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|--------|--------------------|---------------------|--|--|
| Ex. 60 | CH ₃ OH | | light brown crystals (THF) mp: 231.5-232.5°C | C ₁₇ H ₁₄ N ₂ O Calc.: C, 73.37; H, 7.50; N, 14.88 Found: C, 73.34; H, 7.60; N, 14.70 |
| Ex. 61 | NHMs | H | light brown crystals (MeOH) mp: 271.5-274.0°C | C ₁₇ H ₁₄ N ₂ O.S·HCl·1/4H ₂ O Calc.: C, 53.51; H, 5.79; N, 16.42 Found: C, 53.64; H, 5.88; N, 16.30 |
| Ex. 62 | NHMs | Me | light brown crystals (MeOH) mp: 292.0-293.0°C | C ₁₇ H ₁₄ N ₂ O.S·2HCl Calc.: C, 50.85; H, 5.76; N, 14.82 Found: C, 51.00; H, 5.95; N, 14.77 |
| Ex. 63 | NHMs | Et | light brown crystals (iso-PrOH) mp: 202.5-204.0°C | C ₁₇ H ₁₄ N ₂ O.S Calc.: C, 60.99; H, 6.58; N, 16.94 Found: C, 60.96; H, 6.46; N, 16.80 |
| Ex. 64 | NHMs | n-Bu | colorless crystals (EtOH) mp: 275.0-276.5°C | C ₁₇ H ₁₄ N ₂ O.S·2HCl Calc.: C, 53.69; H, 6.46; N, 13.61 Found: C, 53.86; H, 6.36; N, 13.49 |
| Ex. 65 | NHMs | CH ₃ OEt | light brown needle- like crystals (EtOH) mp: 296.0-297.0°C | C ₁₇ H ₁₄ N ₂ O.S·HCl Calc.: C, 55.05; H, 6.30; N, 14.59 Found: C, 55.01; H, 6.27; N, 14.42 |
| Ex. 66 | NHAc | H | light brown crystals (DMF) mp: 294.0-295.5°C | C ₁₇ H ₁₄ N ₂ O·HCl·1/4H ₂ O Calc.: C, 61.53; H, 6.33; N, 17.94 Found: C, 61.46; H, 6.33; N, 18.04 |
| Ex. 67 | NHAc | Me | light brown crystals (THF) mp: 236.0-237.0°C | C ₁₇ H ₁₄ N ₂ O·1/4H ₂ O Calc.: C, 68.54; H, 6.99; N, 19.03 Found: C, 68.76; H, 7.00; N, 18.76 |
| Ex. 68 | NHAc | Et | light brown crystals (MeOH-H ₂ O) mp: 134.0-135.5°C | C ₁₇ H ₁₄ N ₂ O·H ₂ O Calc.: C, 66.81; H, 7.39; N, 17.71 Found: C, 66.67; H, 7.59; N, 17.43 |
| Ex. 69 | NHAc | n-Bu | light brown crystals (MeOH) mp: ≥300°C | C ₁₇ H ₁₄ N ₂ O·HCl·1/2H ₂ O Calc.: C, 63.91; H, 7.38; N, 15.53 Found: C, 64.07; H, 7.17; N, 15.70 |
| Ex. 70 | CHMeNHAc | H | colorless crystals (EtOH) mp: 253.0-254.0°C, decomposed | C ₁₇ H ₁₄ N ₂ O·HCl Calc.: C, 63.83; H, 6.82; N, 16.92 Found: C, 63.53; H, 6.89; N, 16.86 |

Table 81



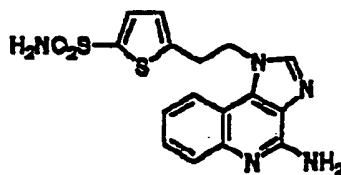
| | Properties |
|--------|--|
| Ex. 71 | brown liquid NMR spectrum δ (CDCl ₃) ppm: 1.20(3H, t, J=7Hz), 1.80-2.00(4H, m), 2.80-3.15(6H, m), 3.01(3H, s), 3.51(2H, q, J=7Hz), 4.36(2H, s), 4.49(2H, t, J=7.5Hz), 4.52(2H, s), 5.39(2H, br-s), 6.66(2H, d, J=8.5Hz), 6.89(2H, d, J=8.5Hz), 7.12-7.40(5H, m) IR spectrum V(liq) cm ⁻¹ : 3320, 3180 Mass spectrum m/z: 469(M ⁺) |

Table 82



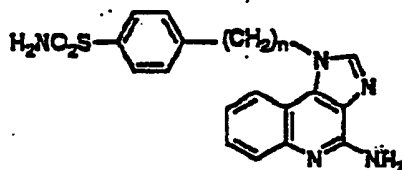
| | R ^a | R ^b | Properties (recrystallization solvent) | Elemental analysis |
|--------|-----------------------------------|----------------|---|---|
| Ex. 72 | o-SO ₂ NH ₂ | H | light yellow crystals (DMF-H ₂ O) mp: 273.0-274.0°C | C ₁₈ H ₁₄ N ₄ O ₂ S Calc.: C, 58.84; H, 4.66; N, 19.06 Found: C, 58.62; H, 4.51; N, 18.85 |
| Ex. 73 | m-SO ₂ NH ₂ | H | light brown crystals (DMF-H ₂ O) mp: 258.5-260.0°C | C ₁₈ H ₁₄ N ₄ O ₂ S Calc.: C, 58.84; H, 4.66; N, 19.06 Found: C, 58.56; H, 4.47; N, 19.12 |
| Ex. 74 | p-SO ₂ NH ₂ | Me | colorless crystals (EtOH) mp: 257.0-257.5°C | C ₁₉ H ₁₆ N ₄ O ₂ S Calc.: C, 59.83; H, 5.02; N, 18.36 Found: C, 59.53; H, 4.79; N, 18.16 |
| Ex. 75 | p-SO ₂ NH ₂ | OMe | light brown needle- like crystals (DMF-H ₂ O) mp: 277.0-278.0°C | C ₁₉ H ₁₆ N ₄ O ₂ S Calc.: C, 57.42; H, 4.82; N, 17.62 Found: C, 57.08; H, 4.66; N, 17.47 |
| Ex. 76 | p-SO ₂ NH ₂ | Cl | light brown crystals (EtOH) mp: 277.0-278.0°C | C ₁₈ H ₁₃ ClN ₄ O ₂ S·9/8H ₂ O Calc.: C, 51.21; H, 4.35; N, 16.50 Found: C, 51.42; H, 4.19; N, 16.22 |

Table 83



| | Properties (recrystallization solvent) | Elemental analysis |
|--------|---|--|
| Ex. 77 | colorless crystals (EtOH) mp: 238.0-239.0°C | $C_{21}H_{21}N_3O_3$ Calc.: C, 51.46; H, 4.05; N, 18.75 Found: C, 51.25; H, 3.91; N, 18.47 |

Table 84



| | n | Properties (recrystallization solvent) | Elemental analysis |
|--------|---|---|---|
| Ex. 78 | 1 | light brown crystals (DMF-H ₂ O) mp: 297.0-299.5°C | $C_{21}H_{21}N_3O_3 \cdot 1/8 H_2O$ Calc.: C, 57.41; H, 4.32; N, 19.69 Found: C, 57.19; H, 4.07; N, 19.40 |
| Ex. 79 | 3 | light brown crystals (DMF-H ₂ O) mp: 289.5-290.5°C | $C_{21}H_{21}N_3O_3 \cdot 1/6 H_2O$ Calc.: C, 59.36; H, 5.07; N, 18.22 Found: C, 59.47; H, 4.85; N, 18.02 |

Example 80

N-[4-[2-(4-amino-2-ethoxymethyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]phenyl]acetamide

A suspension of 2.20 g of N-[4-[2-(4-dibenzylamino-2-ethoxymethyl-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]phenyl] acetamide, 4.00 g of Perlman's reagent and 14.28 g of ammonium formate in 70 ml of methanol was refluxed for 53 hours. The catalyst was filtered off, and the solvent was distilled off under reduced pressure. Water and saturated saline were added to the residue and extraction was performed with methylene chloride. After dewatering the extract, the solvent was distilled off under reduced pressure. The obtained residue was washed with isopropyl ether to obtain 1.24 g of colorless

crystals. Recrystallization from isopropanol yielded colorless crystals with a melting point of 207.0-208.0°C.

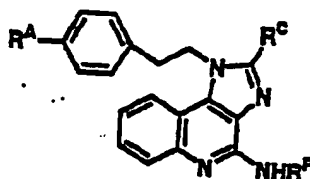
Elemental analysis: $C_{22}H_{14}N_4O_2 \cdot 1/2H_2O$

Calculated: C, 66.97; H, 6.35; N, 16.98

Found: C, 66.90; H, 6.28; N, 16.81

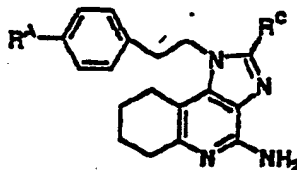
The compounds for Examples 81-84 listed in Tables 85 to 87 were obtained by the same method as Example 80.

Table 85



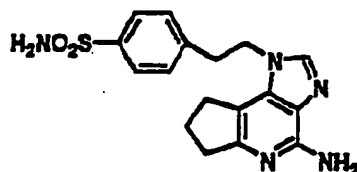
| | R ^A | R ^B | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|--------|---------------------------------|---------------------|----------------|--|---|
| Ex. 81 | CHMeOH | CH ₂ OEt | H | colorless crystals (EtOH) mp: 231.5-232.0°C | $C_{22}H_{14}N_4O_2$ Calc.: C, 70.75; H, 6.71; N, 14.35 Found: C, 70.66; H, 6.74; N, 14.32 |
| Ex. 82 | SO ₂ NH ₂ | H | Me | light yellow crystals (AcOEt) mp: 188.5-189.0°C | $C_{21}H_{12}N_4O_2S$ Calc.: C, 66.22; H, 5.34; N, 14.85 Found: C, 66.01; H, 5.35; N, 14.72 |

Table 86



| | R ^A | R ^B | Properties (recrystallization solvent) | Elemental analysis |
|--------|----------------|---------------------|--|--|
| Ex. 83 | NHAc | CH ₂ OEt | colorless crystals (MeOH) mp: 2300°C | $C_{22}H_{14}N_4O_2 \cdot HCl$ Calc.: C, 62.22; H, 6.81; N, 15.77 Found: C, 62.00; H, 6.87; N, 15.74 |

Table 87



| | Properties (recrystallization solvent) | Elemental analysis |
|--------|---|---|
| Ex. 84 | colorless crystals (MeOH) mp: 275.0-275.5°C | $C_{11}H_{11}N_3 \cdot 1/4H_2O$ Calc.: C, 56.42; H, 5.43; N, 19.43 Found: C, 56.72; H, 5.26; N, 19.18 |

Example 85

1-[2-(4-aminophenyl)ethyl]-1H-imidazo[4,5-c]quinoline-4-amine·hydrochloride

To 8.00 g of N-[4-[2-(4-amino-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]phenyl]acetamide there was added 40 ml of 2 N hydrochloric acid, and the mixture was stirred at 120°C for one hour. After the reaction, a 10% sodium hydroxide aqueous solution was added to adjust the liquid to pH 7, and then the precipitated crystals were filtered off and purified by column chromatography [silica gel, methylene chloride/methanol (20:1)], after which ethanolic hydrogen chloride was added and the precipitated crystals were filtered off to obtain 3.50 g of colorless crystals. Recrystallization from a mixed solution of methanol and water yielded colorless crystals with a melting point of 275.0-283.0°C.

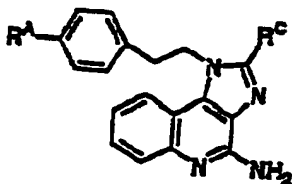
Elemental analysis: $C_{11}H_{11}N_3 \cdot 2HCl \cdot 1/4H_2O$

Calculated: C, 56.78; H, 5.16; N, 18.39

Found: C, 56.78; H, 5.11; N, 18.22

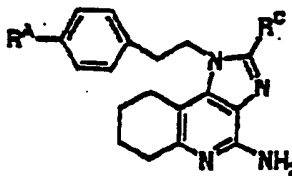
The compounds for Examples 86-104 listed in Tables 88 and 89 were obtained by the same method as Example 85.

Table 88



| | R ¹ | R ² | Properties (recrystallization solvent) | Elemental analysis |
|--------|-----------------|---------------------|---|--|
| Ex. 86 | NH ₂ | Me | light brown crystals (THF) mp: 235.0-236.0°C | C ₁₇ H ₁₂ N ₄ Calc.: C, 71.90; H, 6.03; N, 22.07 Found: C, 71.89; H, 6.24; N, 21.81 |
| Ex. 87 | NH ₂ | Et | faint brown crystals (MeOH-H ₂ O) mp: 202.0-203.0°C | C ₁₉ H ₁₄ N ₄ Calc.: C, 72.48; H, 6.39; N, 21.13 Found: C, 72.64; H, 6.33; N, 20.95 |
| Ex. 88 | NH ₂ | n-Bu | faint brown crystals (AcOEt) mp: 187.0-188.0°C | C ₂₁ H ₁₆ N ₄ Calc.: C, 73.51; H, 7.01; N, 19.48 Found: C, 73.78; H, 6.93; N, 19.34 |
| Ex. 89 | NH ₂ | CH ₃ OEt | colorless crystals (iso-PrOH) mp: 208.0-208.5°C | C ₁₉ H ₁₄ N ₄ O Calc.: C, 69.78; H, 6.41; N, 19.38 Found: C, 69.85; H, 6.40; N, 19.38 |
| Ex. 90 | NHMe | H | colorless crystals (MeOH) mp: 245.0-246.0°C | C ₁₇ H ₁₂ N ₄ ·2HCl·5/4H ₂ O Calc.: C, 55.28; H, 5.74; N, 16.96 Found: C, 55.39; H, 5.52; N, 16.98 |
| Ex. 91 | NHMe | Me | light brown crystals (EtOH) mp: 275.0-276.5°C | C ₁₉ H ₁₄ N ₄ ·2HCl·3/2H ₂ O Calc.: C, 55.69; H, 6.08; N, 16.24 Found: C, 55.76; H, 6.20; N, 16.09 |
| Ex. 92 | NHMe | Et | light brown crystals (EtOH) mp: 271.0-273.0°C | C ₂₁ H ₁₆ N ₄ ·2HCl·H ₂ O Calc.: C, 57.80; H, 6.24; N, 16.05 Found: C, 57.80; H, 6.15; N, 15.95 |
| Ex. 93 | NHMe | n-Bu | light grayish brown crystals (EtOH) mp: 173.0-175.0°C, decomposed | C ₂₃ H ₁₈ N ₄ ·3HCl·1/4H ₂ O Calc.: C, 56.68; H, 6.30; N, 14.37 Found: C, 56.97; H, 6.59; N, 14.08 |
| Ex. 94 | NHMe | CH ₃ OEt | colorless crystals (AcOEt) mp: 156.0-156.5°C | C ₁₉ H ₁₄ N ₄ O Calc.: C, 70.38; H, 6.71; N, 18.65 Found: C, 70.29; H, 6.44; N, 18.49 |

Table 89



| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|---------|---------------------|---------------------|---|--|
| Ex. 95 | NH ₂ | H | light brown crystals (MeOH) mp: 264.0-265.0°C | C ₂₂ H ₁₈ N ₄ ·2HCl Calc.: C, 56.85; H, 6.10; N, 18.41 Found: C, 56.93; H, 6.10; N, 18.42 |
| Ex. 96 | NH ₂ | Me | light brown crystals (AcOEt) mp: 192.0-193.0°C | C ₂₃ H ₁₉ N ₄ Calc.: C, 71.00; H, 7.21; N, 21.79 Found: C, 70.98; H, 7.34; N, 21.49 |
| Ex. 97 | NH ₂ | Et | faint yellow crystals (EtOH) mp: 2285°C, decomposed | C ₂₄ H ₂₀ N ₄ ·2HCl·5/4H ₂ O Calc.: C, 55.75; H, 6.90; N, 16.25 Found: C, 55.80; H, 6.81; N, 16.29 |
| Ex. 98 | NH ₂ | n-Bu | light yellow crystals (iso-PrOH) mp: 245.0-252.0°C, decomposed | C ₂₆ H ₂₂ N ₄ ·2HCl·3/4H ₂ O Calc.: C, 58.73; H, 7.28; N, 15.57 Found: C, 58.51; H, 7.20; N, 15.38 |
| Ex. 99 | NH ₂ | CH ₃ OEt | colorless crystals (EtOH) mp: 259.0-260.0°C | C ₂₃ H ₁₉ N ₄ O·2HCl Calc.: C, 57.53; H, 6.67; N, 15.98 Found: C, 57.52; H, 6.80; N, 15.83 |
| Ex. 100 | NHMe | H | light brown crystals (EtOH) mp: 224.5-225.5°C | C ₂₂ H ₁₉ N ₄ ·2HCl·H ₂ O Calc.: C, 55.34; H, 6.60; N, 16.98 Found: C, 55.17; H, 6.56; N, 17.13 |
| Ex. 101 | NHMe | Me | light brown crystals (EtOH) mp: 284.0-285.0°C | C ₂₃ H ₂₀ N ₄ ·2HCl·7/2H ₂ O Calc.: C, 50.96; H, 7.27; N, 14.86 Found: C, 50.89; H, 7.20; N, 14.79 |
| Ex. 102 | NHMe | Et | brown crystals (EtOH) mp: 274.0-285.0°C, decomposed | C ₂₄ H ₂₁ N ₄ ·2HCl·3H ₂ O Calc.: C, 52.94; H, 7.40; N, 14.70 Found: C, 52.71; H, 7.21; N, 14.69 |
| Ex. 103 | NHMe | n-Bu | colorless crystals (EtOH), mp: 161.0-163.5°C, decomposed | C ₂₆ H ₂₃ N ₄ ·3HCl·5/4H ₂ O Calc.: C, 54.23; H, 7.22; N, 13.75 Found: C, 54.28; H, 7.40; N, 13.83 |
| Ex. 104 | CHMeNH ₂ | H | light brown crystals (EtOH) mp: 207.0-210.0°C, decomposed | C ₂₂ H ₁₉ N ₄ ·2HCl·H ₂ O Calc.: C, 56.34; H, 6.86; N, 16.43 Found: C, 56.38; H, 6.78; N, 16.39 |

Example 105

1-[2-(4-aminophenyl)ethyl]-2-n-butyl-1H-imidazo[4,5-c]quinoline-4-amine

A suspension of 18.8 g of 1-[2-[4-(dibenzylamino)phenyl]ethyl]-2-n-butyl-1H-imidazo[4,5-c]quinoline-4-amine, 3.76 g of Perlman's reagent, 33.0 g of ammonium formate and 600 ml of methanol was refluxed for 7 hours. The catalyst was filtered off and the solvent was distilled off. Water was added to the

obtained residue, the liquid was adjusted to pH 9 with a 10% sodium hydroxide aqueous solution, and extraction was performed with methylene chloride. After washing the extract with water and dewatering, the solvent was distilled off and the obtained residue was washed with ethyl acetate and recrystallized from isopropanol to obtain colorless crystals with a melting point of 191.0-192.0°C.

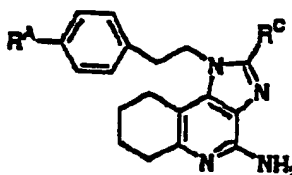
Elemental analysis: $C_{22}H_{22}N_2$

Calculated: C, 73.51; H, 7.01; N, 19.48

Found: C, 73.41; H, 6.90; N, 19.22

The compound for Example 106 listed in Table 90 was obtained by the same method as Example 105.

Table 90



| | R ^A | R ^C | Properties (recrystallization solvent) | Elemental analysis |
|---------|----------------|---------------------|--|--|
| Ex. 106 | NHMe | CH ₂ OEt | light brown crystals - (AcOEt) mp: 127.0-128.5°C | $C_{22}H_{22}N_2O$ Calc.: C, 69.63; H, 7.70; N, 18.45 Found: C, 69.67; H, 7.69; N, 18.17 |

Example 107

1-[2-(4-aminophenyl)ethyl]-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine hydrochloride

A mixture of 0.81 g of N,N-dibenzyl-1-[2-[4-(dibenzylamino)phenyl]ethyl]-1,6,7,8-tetrahydrocyclopenta[b]imidazo[4,5-d]pyridine-4-amine, 0.16 g of Perlman's reagent, 1.56 g of ammonium formate and 40 ml of methanol was refluxed for 30.5 hours. The catalyst was filtered off, and the solvent was distilled off. Water was added to the residue, the liquid was adjusted to pH 9 with a 10% potassium carbonate aqueous solution, and methylene chloride was added. The precipitated crystals were filtered off, and after separating off the

methylene chloride layer, the aqueous layer was further extracted with methylene chloride. The methylene chloride layer was dewatered, and then the solvent was distilled off to obtain colorless crystals. These were combined with the previous crystals and a common method was used to obtain 0.41 g of colorless crystals as a hydrochloride. Recrystallization from methanol yielded colorless crystals with a melting point of 259.0-260.0°C (decomposed).

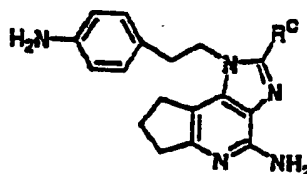
Elemental analysis: $C_{17}H_{14}N_4 \cdot 2HCl$

Calculated: C, 55.74; H, 5.78; N, 19.12

Found: C, 55.76; H, 5.89; N, 19.07

The compounds for Examples 108-109 listed in Table 91 were obtained by the same method as Example 107.

Table 91



| | R ^c | Properties (recrystallization solvent) | Elemental analysis |
|---------|---------------------|--|---|
| Ex. 108 | Et | light yellowish brown crystals (EtOH) mp: 266.0-268.0°C, decomposed | $C_{17}H_{14}N_4 \cdot 2HCl \cdot 1/3EtOH \cdot H_2O$ Calc.: C, 55.23; H, 6.83; N, 16.37 Found: C, 55.24; H, 6.84; N, 16.57 |
| Ex. 109 | CH ₃ OEt | light brown crystals (EtOH) mp: 250.5-251.5°C, decomposed | $C_{17}H_{14}N_4O \cdot 2HCl \cdot 1/4H_2O$ Calc.: C, 56.01; H, 6.46; N, 16.33 Found: C, 56.23; H, 6.31; N, 16.08 |

Example 110

1-[2-(4-ureidophenyl)ethyl]-1H-imidazo[4,5-c]quinoline-4-amine

After dissolving 800 mg of 1-[2-(4-aminophenyl)ethyl]-1H-imidazo[4,5-c]quinoline-4-amine in a mixed solution of 8 ml of acetic acid and 4.8 ml of water, a solution of 400 mg of sodium cyanate in 4.8 ml of water was added while stirring at room temperature, and stirring at room temperature was continued for 2 hours. After adding a 10% sodium hydroxide aqueous solution to the reaction solution to adjust the liquid to pH 9 and

filtering off the crystals, they were washed with water to obtain 790 mg of crystals. Recrystallization from a mixed solution of ethanol and water yielded faint brown crystals with a melting point of 300°C or higher.

Elemental analysis: $C_{14}H_{14}N_2O$

Calculated: C, 65.88; H, 5.24; N, 24.26

Found: C, 66.00; H, 5.14; N, 24.07

Example 111

1-[2-[4-(N'-methylthioureido)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine

To 800 mg of 1-[2-(4-aminophenyl)ethyl]-1H-imidazo[4,5-c]quinoline-4-amine there were added 24 ml of methanol and 0.60 ml of methyl isothiocyanate, and the mixture was stirred at 40°C for 15 hours. After cooling the reaction solution, the precipitated crystals were filtered off to obtain 770 mg of crystals. Recrystallization from a mixed solution of ethanol and water yielded faint brown crystals with a melting point of 220.0-221.5°C.

Elemental analysis: $C_{16}H_{16}N_4S$

Calculated: C, 63.81; H, 5.35; N, 22.32

Found: C, 63.60; H, 5.13; N, 22.05

Example 112

1-[2-(4-acetylphenyl)ethyl]-1H-imidazo[4,5-c]quinoline-4-amine

To 3.89 g of 2-[4-[2-(4-phenoxy-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]phenyl-2-methyl-1,3-dioxolane there was added 33.2 g of ammonium acetate, and the mixture was stirred at 140°C for 3 hours. After the reaction, a 10% sodium hydroxide aqueous solution was added to adjust the liquid to pH 8, and then the precipitated crystals were filtered off and washed with water to obtain 2.83 g of light brown crystals. Recrystallization from a mixed solution of methylene chloride and methanol yielded colorless crystals with a melting point of 267.0-269.0°C.

Elemental analysis: $C_{26}H_{26}N_2O$

Calculated: C, 72.71; H, 5.49; N, 16.96

Found: C, 72.41; H, 5.34; N, 16.70

Example 113

1-[2-[4-(1-hydroxyiminoethyl)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine

To 1.63 g of 1-[2-(4-acetylphenyl)ethyl]-1H-imidazo[4,5-c]quinoline-4-amine there were added 0.38 g of hydroxylamine hydrochloride, 1.34 g of sodium acetate·3H₂O and 16 ml of ethanol, and the mixture was refluxed for 2 hours. After concentrating the reaction solution under reduced pressure, water was added and the precipitated crystals were filtered off to obtain 1.47 g of crystals. Recrystallization from a mixed solution of ethanol and water yielded faint brown crystals with a melting point of 269.0-270.5°C.

Elemental analysis: C₂₀H₁₇N₃O

Calculated: C, 69.55; H, 5.54; N, 20.28

Found: C, 69.34; H, 5.54; N, 20.11

Example 114

1-[2-[4-(1-aminoethyl)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine

To 500 mg of 1-[2-[4-(1-hydroxyiminoethyl)phenyl]ethyl]-1H-imidazo[4,5-c]quinoline-4-amine there were added 150 ml of 10% methanolic ammonia and 1-ml of Raney nickel, and the mixture was stirred under a hydrogen pressure of 5 atmospheres at 50°C for 80 hours. After cooling the reaction solution, the solvent was filtered off and concentrated under reduced pressure to obtain 300 mg of crystals. Recrystallization from ethanol yielded faint brown crystals with a melting point of 222.0-224.0°C.

Elemental analysis: C₂₀H₁₇N₃

Calculated: C, 72.48; H, 6.39; N, 21.13

Found: C, 72.46; H, 6.39; N, 20.86

Example 115

Ethyl 4-[2-(4-amino-1H-imidazo[4,5-c]quinolin-1-yl)ethyl]benzoate

To 550 mg of 4-[2-(4-amino-1H-imidazo[4,5-c]quinolin-1-yl)ethyl] benzoic acid there were added 28 ml of ethanol and 2.8

ml of concentrated sulfuric acid, and the mixture was refluxed for 5 hours. After concentrating the reaction solution under reduced pressure, water and a 10% sodium hydroxide aqueous solution were added to adjust the liquid to pH 9, and the precipitated crystals were filtered off to obtain 550 mg of light brown crystals. Recrystallization from methanol yielded light brown needle-like crystals with a melting point of 180.0-182.0°C.

Elemental analysis: $C_{14}H_{12}N_4O_2$

Calculated: C, 69.98; H, 5.59; N, 15.55

Found: C, 69.98; H, 5.39; N, 15.62

Experimental Example 1: Interferon α inductivity in human cells

Table 1 shows interferon α inductivities in human cells for the purpose of demonstrating the excellent effect of the compounds of the invention. The following compounds were used as the control agents.

Control agent A: 1-isobutyl-1H-imidazo[4,5-c]quinoline-4-amine
(common name: imiquimod)

Control agent B: 1-(2-phenylethyl)-1H-imidazo[4,5-c]quinoline-4-amine

1. Preparation of blood cells for culturing

Whole blood was collected by venipuncture into a 50 ml centrifuge tube containing 170 μ l of Novo Heparin Injection 1000 (Novo Nordisk A/S). Peripheral blood monocytes (PBMCs) were prepared with a Leuco PREPTM (Becton Dickinson; Reorder No. 2751) cell separation tube, and were cultured to a cell density of 1×10^6 cells/ml in RPM-1640 medium (Nissui Pharmaceuticals, KK.; Code 05918) containing 2 mM L-glutamine (LIFE TECHNOLOGIES; Cat. No. 25030-016) and a penicillin-streptomycin solution (final concentration: 100 U/ml penicillin, 100 μ g/ml streptomycin, LIFE TECHNOLOGIES; Cat. No. 15145-014) to which 10% fetal bovine serum (INTERGEN COMPANY; Cat. No. 1020-90) had been added.

2. Preparation of compounds

The compounds were suspended to 1 mg/ml in 0.1 N hydrochloric acid and then solubilized by dilution with physiological saline. The compounds were tested in a concentration range of 0.03 µg/ml to 3.0 µg/ml.

3. Incubation

A 50 µl portion of the test compound solution or solvent was added to a 96-well (flat-bottom) MicroTest III™ (Becton Dickinson; FALCON 3072) cell culturing plate, and 200 µl of the PMBC in the medium was added to each full well. The plate was covered with a plastic lid and incubated for two days at 37°C in a 5% carbon dioxide atmosphere.

4. Separation

Following the incubation, the plate was coated with PLATE SEALER S (Coster Corporation; Cat. No. 3095) and then centrifuged at 2000 rpm (740xG, rotor; RS-96SA/6) in a Universal cooling centrifuge (KUBOTA 5800, manufactured by Kubota Laboratories) at 4°C for 5 minutes. The culture supernatants were used as samples.

5. Interferon α assay

This was accomplished by enzyme immunoassay. Using a Cytoscreen™ human interferon α assay kit (BIOSOURCE; Cat. #ASY-05), a 96-well plate immobilizing mouse anti-human interferon α monoclonal antibodies (primary antibodies) was subjected to an antigen-antibody reaction to bind the interferon α in 100 µl of sample. Subsequent binding of rabbit anti-human interferon α polyclonal antibodies (secondary antibodies) was followed by binding of anti-rabbit antibodies labeled with peroxidase. Tetramethylbenzidine was used for coloration and the reaction was terminated. The absorbance at 450 nm was then measured with a Vmax kinetic microplate reader (Molecular Devices). All of the results were obtained with the values expressed in pg/ml based on an interferon α standard curve. The results are shown in Tables 92 and 93.

Table 92

| Compound | Interferon α inductivity (pg/ml) | | | | | |
|------------|---|------|------|------|------|------|
| | Dose concentration (pg/ml) | | | | | |
| | 0.01 | 0.03 | 0.10 | 0.3 | 1 | 3 |
| Example 9 | 12 | 43 | 387 | 818 | 619 | 313 |
| Example 10 | 1019 | 953 | 682 | 436 | 314 | 191 |
| Example 11 | 850 | 966 | 726 | 570 | 346 | 161 |
| Example 12 | 15 | 740 | 860 | 697 | 337 | 139 |
| Example 13 | 658 | 645 | 240 | 208 | 132 | 86 |
| Example 18 | 180 | 557 | 417 | 222 | 156 | 103 |
| Example 23 | 1018 | 3052 | 2072 | 1556 | 1233 | 1133 |
| Example 42 | 86 | 668 | 194 | 167 | 85 | 35 |
| Example 43 | 130 | 229 | 449 | 327 | 219 | 201 |
| Example 45 | - | - | 67 | 746 | 879 | 960 |
| Example 48 | - | 73 | 644 | 735 | 629 | 436 |
| Example 50 | - | - | 492 | 1003 | 759 | 288 |
| Example 56 | 843 | 771 | 620 | 534 | 580 | 560 |
| Example 59 | - | 358 | 698 | 964 | 980 | 947 |
| Example 62 | 683 | 777 | 731 | 785 | 734 | 849 |
| Example 64 | 663 | 796 | 711 | 649 | 651 | 606 |
| Example 65 | - | 992 | 607 | 519 | 419 | - |
| Example 67 | 8840 | 577 | 268 | 236 | 112 | - |
| Example 69 | 664 | 1014 | 758 | 569 | 343 | 217 |
| Example 70 | - | - | 1246 | 1197 | 931 | 651 |
| Example 80 | - | 342 | 194 | 459 | 538 | - |
| Example 83 | 727 | 778 | 817 | 589 | 507 | - |
| Example 84 | - | - | 3 | 638 | 679 | 520 |
| Example 85 | 0 | 639 | 745 | 628 | 600 | 598 |
| Example 86 | 905 | 469 | 173 | 123 | 79 | - |
| Example 87 | - | 732 | 571 | 763 | 717 | - |
| Example 88 | - | 459 | 491 | 607 | 545 | - |

Table 93

| Compound | Interferon α inductivity (pg/ml) | | | | | |
|-----------------|---|------|------|------|-----|-----|
| | Dose concentration (μ g/ml) | | | | | |
| | 0.01 | 0.03 | 0.10 | 0.3 | 1 | 3 |
| Example 89 | - | 602 | 493 | 756 | 768 | - |
| Example 94 | - | 869 | 875 | 794 | 771 | 717 |
| Example 95 | - | 786 | 475 | 765 | 553 | - |
| Example 96 | 1012 | 1099 | 1336 | 1100 | 794 | 780 |
| Example 98 | 854 | 263 | 341 | 233 | 190 | - |
| Example 99 | 557 | 347 | 238 | 230 | 189 | 155 |
| Example 101 | 135 | 463 | 760 | 764 | 598 | 457 |
| Example 106 | 353 | 553 | 668 | 659 | 602 | 576 |
| Example 107 | - | - | 737 | 336 | 546 | 381 |
| Control agent A | - | 22 | 29 | 73 | 50 | 34 |
| Control agent B | - | 28 | 62 | 69 | 68 | 49 |

The compounds of the invention exhibited more excellent interferon α inductivity than the control agents, and are therefore highly useful for treatment of diseases caused by viruses, such as rheumatoid arthritis, warts, hepatitis B, hepatitis C, etc. and for cancer and other neoplastic diseases. [Effect of the Invention]

The compounds of the invention have excellent interferon inductivity and are therefore highly useful for treatment of diseases caused by viruses, such as rheumatoid arthritis, warts, hepatitis B, hepatitis C, etc. and for cancer and other neoplastic diseases.

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